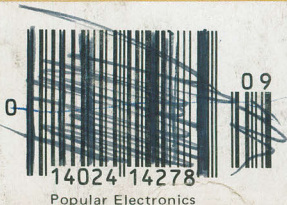
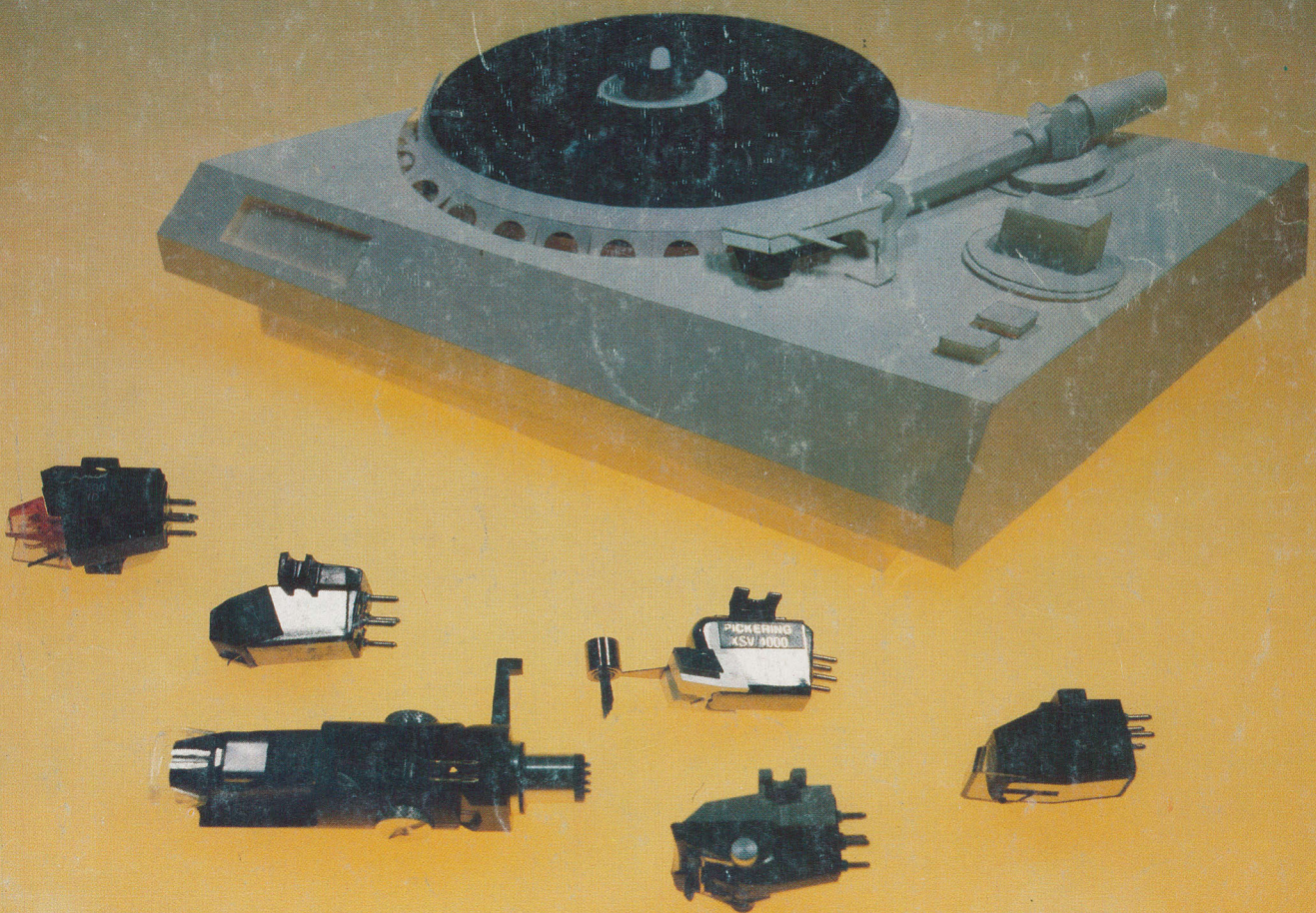


Popular Electronics®

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE SEPTEMBER 1980/95¢

- * TRS-80 Data Tape Conditioner
- * Degree-Day Meter Monitors Heat Loss
- * Measuring Large Currents With DMMs

PE Compares Six Phono Pickups



Audio Product of the Month:

Tandberg Model TCD-440A Cassette Deck

Kevin Towne

The man, the lig



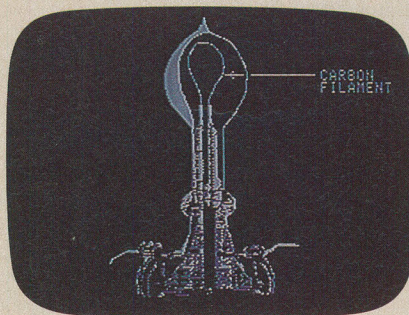
ht and the Apple.

If you could talk to Thomas Edison, he'd tell you what it was like to turn the lights on in 1879. You could tell him about some bright ideas of the 20th century... particularly, a technological phenomenon that can handle everything from solar heat control to lighting your home via voice command. The Apple personal computer.

Expand your own inventiveness with the always-expandable Apple.

Take a look inside your local computer store. There's a range of Apple systems for you... whether you want expansion capabilities of four or eight accessory slots... or memory expandable to 64K bytes or 128K bytes. With this kind of flexibility, the possibilities for creating your own computer system are endless.

Want to add an A to D conversion board? Apple makes it happen. Want to plug into time sharing, news and elec-



With Apple, Edison could've written a program to determine why some filaments burned longer than others.

tronic mail services? Apple does it all. Because Apple is the most popular personal computer with the least complicated interface, over 100 companies supply peripherals for the Apple family... including an IEEE 488 bus for instant control.

Disk drives, a tool kit and creativity in color.

Apple was one of the first to use disk drives for increased performance and application versatility. Today, our 5 $\frac{1}{4}$ " disk drive offers high density (143K bytes),

high speed and low cost. No wonder this drive is the most popular on the market.

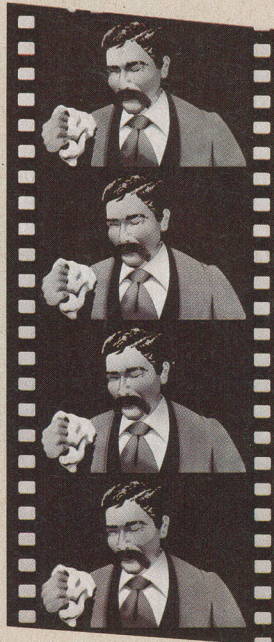
But now Apple goes one better with the DOS Tool Kit. A series of utility programs, it gives you the freedom to easily design 280h x 192v graphic displays in a palette of living color... depending on your choice of Apple system.

Edison was first with the movie camera and projector. Now, with Apple's DOS Tool Kit, you can be first to work wonders with colorful creative animation.

Imagine the broadest line of software programs ever.

Apple's broad line of peripherals is equalled only by the most extensive line of software you'll find in the personal computing world. Since more than 170 companies offer software for the Apple family, you can have one of the most impressive program libraries ever.

When you write your own programs, your Apple speaks creatively in BASIC,



Edison had the first movie camera... and Apple has the DOS Tool Kit that takes you into the colorful world of animation.

Pascal, FORTRAN, PILOT and 6502 assembly language. Use these languages to score a sonata. Apple will play back your musical masterpiece on its built-in speaker.

Edison listened to his voice on a revolutionary phonograph in the 1800s... now you can listen to the sounds of today with Apple's inventive family of personal computers.

Where to find even more illuminating Apple experiences.

There's always something new being invented at Apple to set your imagination soaring. And there's always an expert to tell you all about it in detail. Your Apple dealer. If you already own an Apple, there's a whole future ahead to

challenge man, mind and machine.

If you're considering a personal computer, stop by the computer store and compare. Apple's reliability, proven performance and recognized technological leadership will help you see the light. Don't let history pass you by. Visit your nearest Apple dealer, or call 800-538-9696. In California, 800-662-9238.

 **apple® computer**



TRS-80* Computer Compatible ...

Quality is the real difference. Low price is merely a dividend.

**High quality.
Competitive pricing.
And a proven track record.**

Three reasons why Percom is the industry's number one independent manufacturer of mini-disk systems for microcomputers.

And if you're looking at mini-disk drives, extra storage capacity is an added bonus.

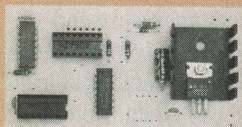
In fact, you store almost one fifth more data on Percom TFD-100™ drives and over two-and-one-fourth times as much on TFD-200™ drives.

Besides extra testing and superior design, you get free, with each system, a software patch on minidiskette that not only upgrades TRSDOS* for operation with the newer 40- and 77-track drives, but also deglitches version 2.1.

Available in 1-, 2- and 3-drive configurations, Percom drives for the TRS-80* computer start as low as \$399.

CIRCLE NO. 57 ON FREE INFORMATION CARD

The gift of speech



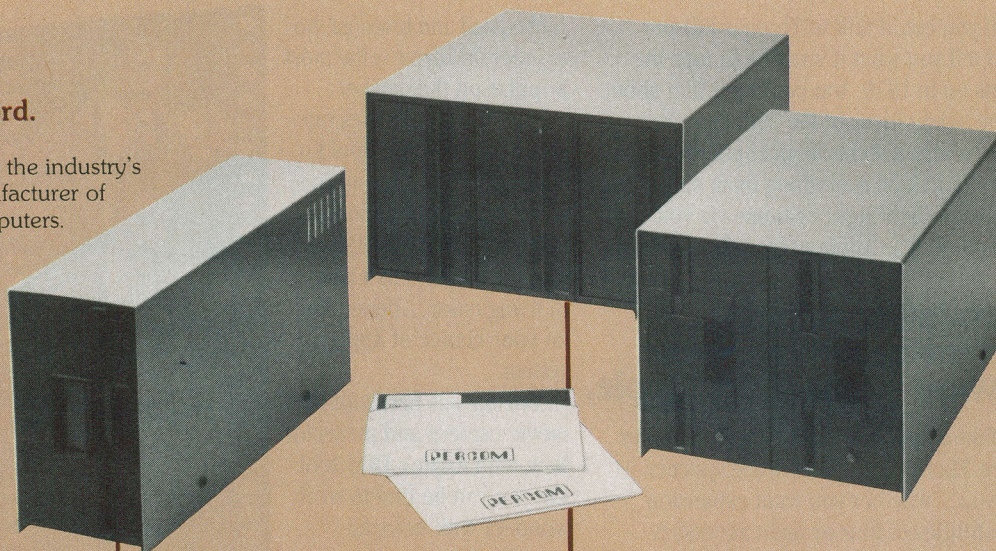
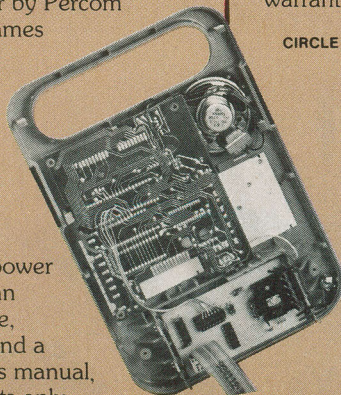
Called Speak-2-Me-2™, this clever interface module makes a Texas Instruments'

Speak & Spell† the voice of your computer — announcing, imploring, commanding with expressions and sentences created from the Speak & Spell† vocabulary.

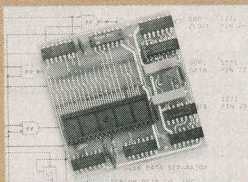
Speech is controlled either at the keyboard or by your own Level II BASIC programs. Or by Percom minidiskette word games (available soon).

Speak-2-Me-2™ is installed in the battery compartment of your Speak & Spell†, and power is provided from an ordinary calculator power pak. Supplied with an interconnecting cable, operating software and a comprehensive users manual, Speak-2-Me-2™ costs only \$69.95. (Speak & Spell™ not included.)

CIRCLE NO. 58 ON FREE INFORMATION CARD



the Separator:™ End "CRC error. Track locked out!"



TRS-80* computer systems. The SEPARATOR™, so called, is installed in the Expansion Interface without modifying the host system. When installed, data and clock signals are reliably separated during playback, an essential function that the separator circuitry of the host computer performs very poorly. Price is only \$29.95.

Note. Opening the Expansion Interface may void the Tandy limited 90-day warranty.

CIRCLE NO. 59 ON FREE INFORMATION CARD

This plug-in adapter virtually eliminates data read errors, a problem that plagues

Quality Percom products are available at Percom dealers nationwide. **Call Percom's toll-free order number, 1-800-527-1592, for the address of your nearest dealer or to order direct.**

PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERCOM DATA COMPANY, INC.
211 N. KIRBY GARLAND, TEXAS 75042
(214) 272-3421

OS-80™ uses Level II BASIC commands

With OS-80™, Level II BASIC commands are used for DOS and Disk BASIC functions.

You extend the OS-80™ utility set indefinitely with your own BASIC disk-resident utilities.

OS-80™ resides in less than 7-Kbytes of RAM.

The program is supplied on minidiskette along with a simple file manager, BASIC disk utilities and an OS-80™ "Handbook" that you expand and maintain.

All are helpful programming examples.

Price, with instruction manual, \$29.95.

NEW! OS-80™
Machine Language
SAVE / LOAD
Utility. Only
\$19.95 on
minidiskette w/instructions.



CIRCLE NO. 60 ON FREE INFORMATION CARD

PERCOM

™ trademark of Percom Data Company, Inc.

* trademark of Tandy Radio Shack Corporation which has no relationship to Percom Data Company.

† trademark of Texas Instruments, Inc.

Popular Electronics®

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

Feature Articles

PE REVIEWS SIX STEREO PHONO CARTRIDGES /Harold A. Rodgers	62
MEASURING LARGE CURRENTS WITH A DMM /Robert H. Johns	90
SPECIAL COUNTER CIRCUITS FOR EXPERIMENTERS /Patrick J. Delaney	98

Construction Articles

AUDIO TIME DELAY SYSTEMS: BUILD A DIGITAL AUDIO DELAY LINE / John Neves, Steve Kolupaev, Debbie Delahanty	68
HARDWARE-SOFTWARE TAPE CONDITIONER FOR TRS-80 COMPUTERS /Cass Lewart	76
CHECK HEAT LOSS WITH A DEGREE-DAY METER /Rush W. Hood	85
ACTIVE FILTER IMPROVES MORSE CODE READABILITY /Lou Dezettel	102

Equipment Reviews

TANDBERG MODEL TCD-440A CASSETTE TAPE DECK	25
GENERAL ELECTRIC 19" MODEL 19EC0770W TABLE-TOP COLOR TV	35

Columns

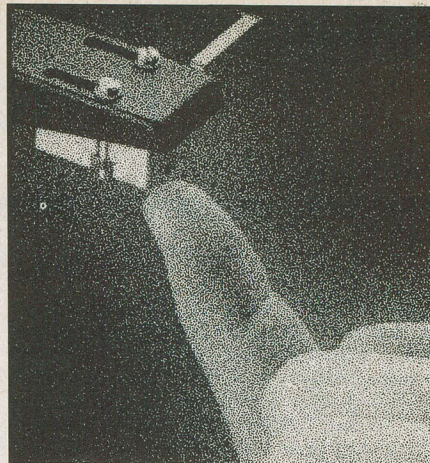
ENTERTAINMENT ELECTRONICS /Laurence Greenhill <i>High-End Audio.</i>	21
COMPUTER BITS /Carl Warren <i>New Equipment and Handy Hints.</i>	46
COMPUTER SOURCES /Leslie Solomon	58
SOLID-STATE DEVELOPMENTS /Forrest M. Mims <i>A Solid-State Detective Story.</i>	105
HOBBY SCENE /John J. McVeigh	110
EXPERIMENTER'S CORNER /Forrest M. Mims <i>Integrated Polarity Converter.</i>	112
DX LISTENING /Glenn Hauser <i>USAF Starts Radar on Shortwave Broadcast Bands.</i>	117
PROJECT OF THE MONTH /Forrest M. Mims <i>X100 Frequency Multiplier.</i>	128

Departments

EDITORIAL /Art Salsberg <i>Fall Electronic Product Preview.</i>	4
LETTERS	6
NEW PRODUCTS	11
TIPS AND TECHNIQUES	120
ELECTRONICS LIBRARY	122
NEW LITERATURE	123
OPERATION ASSIST	124
ADVERTISERS INDEX	136
PERSONAL ELECTRONICS NEWS	142

COVER PHOTO: MARK CANTOR; Paper sculpture by Jerry Cable

COPYRIGHT © 1980 BY ZIFF-DAVIS PUBLISHING COMPANY. All rights reserved. Popular Electronics (ISSN 0032-4485) September 1980, Volume 18, Number 3. Published monthly by Ziff-Davis Publishing Co., at One Park Ave., New York, NY 10016. Philip B. Korsant, President; Selwyn Taubman, Treasurer; Bertram A. Abrams, Secretary. One year subscription rate for U.S. and Possessions, \$14.00; Canada, \$17.00; all other countries, \$19.00 (cash orders only, payable in U.S. currency). Controlled circulation Postage Paid at Salem, IL 62881. Authorized as second class mail by the Post Office Dept., Ottawa, Canada, and for payment of postage in cash. POPULAR ELECTRONICS including ELECTRONICS WORLD, Trade Mark Registered. Indexed in the Reader's Guide to Periodical Literature. Ziff-Davis also publishes Boating, Car and Driver, Cycle, Flying, Popular Photography, Skiing, Stereo Review, Electronic Experimenter's Handbook, and Tape Recording & Buying Guide. **Forms 3579 and all Subscription Correspondence:** POPULAR ELECTRONICS, Circulation Dept., P.O. Box 2774, Boulder, CO 80302. Please allow at least eight weeks for change of address, enclosing, if possible, an address label from a recent issue. **Permissions.** Material in this publication may not be reproduced in any form without permission. Requests for permission should be directed to Jerry Schneider, Rights and Permissions, Ziff-Davis Publishing Co., One Park Ave., New York, NY 10016.



SC-2 gives your cartridge more than The Finger!

The famous SC-1 stylus brush (standard of the record and hifi industries) now has a synergistic fluid called SC-2.

SC-2 Fluid enhances and speeds cleaning and yet protects diamond adhesives, cartridge mounting polymers and fine-metal cantilevers against the corrosive effects of many other "cleaners."

The Discwasher SC-2 System. Stylus care you can finger as clearly superior.



discwasher®
PRODUCTS TO CARE FOR YOUR MUSIC

1407 N. Providence Rd.
Columbia, Missouri 65201

CIRCLE NO. 23 ON FREE INFORMATION CARD

Editorial

Fall Electronic Product Preview

ANOTHER summer Consumer Electronics Show has passed. As in other years, manufacturers introduced their upcoming products to dealers, giving us an early view of what stores might carry in the fall and winter. Unlike other times, however, there were fewer design innovations around to excite us. Here are some of the more interesting new developments.

In TV, Zenith showed a "Space Phone" device that allows a color TV set to be used as an extension telephone. Offered on five upcoming color TV models, the system allows an incoming phone call to be switched by the set's remote control to the TV model's speakers, while an activated built-in microphone permits anyone present to talk to the caller. Sanyo showcased a 19" color TV receiver with two 5" black and white screens built in on one side so that viewers can monitor other channels or use the smaller screens for security purposes. Front-loading tape came to video cassette recorders with Sharp Electronics' new six-hour VHS Model VC-7400, perhaps portending a trend. And 2"- and 3"-TV/radio/cassette portables were plentiful.

In the computer field, Lexicon, the company that launched the first language translator (now marketed by Nixdorf) introduced an attractive 300-baud acoustically coupled modem with a battery-powered option. APF Electronics displayed its personal computer with an add-on mini-floppy. System retail price? \$995! Ohio Scientific debuted its new C8P-HD personal computer system that has,

among other features, a voice recognition capability of several hundred spoken words. Moreover, a hard disk is used to store the phonetic representation of the 3500 most common short words in the English language. Nixdorf introduced its portable data terminal at the show, too. And Panasonic displayed its RL-H1000 hand-held computer system, which uses a 6502 CPU. A new structured software system, SNAP, was developed for the computer. Micro-memory capsules are used. Further, the 23/4" x 15" x 8" system incorporates a keyboard, mini-printer and acoustic coupler!

There were electronic games, wristwatches and telephone systems galore. Casio's "Melody" wristwatch model caught our ears. The timepiece has seven different musical alarms, one for each day of the week. Moreover, the watch has a date memory for playing selected tunes. As a result, the user can select Happy Birthday or the Wedding March as a reminder when such an event's day is reached. In the telephone product area, Universal Security Instrument's "Intelliphone" was demonstrated to show off its sophisticated features, such as storing 11 numbers in memory, automatic redialing of a busy telephone number for up to ten minutes, HELP button for instant emergency dialing, and resettable elapsed timer, among other functions.

For public-service band buffs, there was Antenna Inc.'s new all-band "Persuader" scanner indoor antenna (\$11.95), a welcome hideaway device said to outperform the little

telescopic antenna supplied with scanners. Walking through the aisles we spotted Robins Industries' "Whistle Stop" cassette head demagnetizer. It emits a whistling tone when it's demagnetizing. The maker claims that the job is done when the whistle ceases after four to six seconds. We also noted ITT's new one-piece pushbutton telephone, which slides open to engage the line and is squeezed closed to hang up, making for a tidy compact package.

Hal Rodgers observed that updates in audio amplifier technology were few. One of the exceptions was in Sony's high-end Esprit series, with a power amp that works in a modified Class A and uses no output-to-input negative feedback. Standing out among speakers was the \$20,000 Infinity Reference System. Each column (there are two per side) measures 7 1/2-feet high. They contain six 12" woofers each, driven by 1.5 kW of amp power. The tweeter/midrange columns each contain 36 electromagnetic induction tweeters and 12 similar midrange drivers. Hal said that the cannon shots from Soundstream's digital tape of Tchaikovsky's 1812 Overture were enough to set your clothing flapping.

For the most part, the rest of audio technology at CES came down to the addition of memory, more digital readouts, and microprocessor control. Perhaps the most elaborate product in this area was the dbx 20/20, a 6502-CPU-based equalizer. Using its internal pink-noise source, it will automatically equalize a room to the flattest setting achievable with 10 bands of EQ. It also "remembers" different settings that can be called up at the touch of a button.

While, the microprocessor continues to spark new developments—even new industries—the more mature section of the industry concentrates on convenience and styling.

Art Salsberg

JOE MESICS

Publisher

ARTHUR P. SALSBERG

Editorial Director

HAROLD A. RODGERS

Executive Editor

LESLIE SOLOMON

Senior Technical Editor

JOHN R. RIGGS

Managing Editor

EDWARD I. BUXBAUM

Art Director

ALEXANDER W. BURAWA

Features Editor

JOHN J. McVEIGH

Technical Editor

ANDRE DUZANT

Technical Illustrator

CARMEN ROBLES

Production Editor

JEFF NEWMAN

Editorial Assistant

Contributing Editors

Carl Warren, Stan Prentiss

Glenn Hauser, Julian Hirsch, Forrest Mims

MARIE MAESTRI

Executive Assistant

OLIVIA WILSON

Promotion Coordinator

PEARL HARRINGTON

Assistant to the Publishing Director

SIDNEY HOLTZ

Publishing Director

Popular Electronics®

Editorial and Executive Offices

One Park Avenue
New York, New York 10016
212 725-3500

Publisher

Joe Mesics
212 725-3568

New York Office

Advertising Manager:
Richard Govatski (725-3939)

Eastern Advertising Manager

Bonnie B. Kaiser (725-3580)
Richard B. Eicher (725-3578)

Midwestern Office

Suite 1400, 180 N. Michigan Ave.,
Chicago, IL 60601 (312 346-2600)
Sales: Ted Welch

Western Representative

Norman S. Schindler & Associates, Inc.
7050 Owensmouth Ave., #209
Canoga Park, CA 91303 (213 999-1414)
Sales: Norm Schindler, Jon Marshall

Representation in Japan

James Yagi
Oji Palace Aoyama
6-25, Minami Aoyama, 6 Chome, Minato-Ku
Tokyo, Japan (407-1930/6821, 582-2851)

Ziff-Davis Publishing Company

Philip B. Korsant
Richard Friese
Phillip T. Heffernan
Sidney Holtz
Edward D. Muhlfeld
Philip Sine
Albert S. Traina
Robert Bavier
Paul Chook (Research)
Baird Davis (Production)
Edgar Hopper (Marketing)
George Morrissey
Selwyn Taubman
Bertram A. Abrams

President
Senior Vice President
Senior Vice President
Senior Vice President
Senior Vice President
Senior Vice President
Senior Vice President
Vice President
Vice President
Vice President
Vice President
Treasurer
Secretary

W. Bradford Briggs

Vice Chairman

Ziff Corporation

William Ziff
I. Martin Pompadur
Hershel B. Sarbin
Furman Hebb
Bruce Maggin
Lawrence Sporn

Chairman
President
Executive Vice President
Vice President
Vice President
Vice President

Editorial correspondence: POPULAR ELECTRONICS, 1 Park Ave., New York, NY 10016. Editorial contributions must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models submitted.

The publisher has no knowledge of any proprietary rights which will be violated by the making or using of any items disclosed in this issue.



Member Audit Bureau
of Circulations

POPULAR ELECTRONICS

The Omen • Breaking Away • Norma Rae • The French Connection
Butch Cassidy and the Sundance Kid • Citizen Kane • Julia
The Rose • Poseidon Adventure • King Kong (1933) • An Unmarried
Woman • The Turning Point • Carnal Knowledge • M*A*S*H •
The Graduate • Alien

Videocassette Movies in your own home

from The Video Club
of America

You can choose from over 300 of the most-wanted videocassette movies and programs on the market today when you join THE VIDEO CLUB OF AMERICA. The quality is tops; you can purchase a full-length film for as little as \$44.95; and it costs only \$10 to join the Club for a lifetime. THE VIDEO CLUB OF AMERICA is a convenient source for all your video needs—including blank videocassettes and accessories. You'll receive only those items you specifically order AND YOU ARE NEVER OBLIGATED TO BUY. So why not send your membership order today? Join immediately and you'll receive a special "2-for-1 coupon" entitling you to a FREE videocassette with the first one you buy of equal or greater value! As a member you'll also receive our 38-page, full-color 1980 Program Catalog (VHS or Beta-II formats available).

Extra Club benefit: "Unadvertised Weekly Specials"

You'll be eligible to phone in for weekly Video Club "Unadvertised Specials" like 2 videocassette movies for \$50, or a free blank videocassette for each movie you purchase. In addition, as a Club member, you will receive our quarterly newsletter about special Club discounts. You will also receive a glossary of video terms and an equipment display sheet to help you shop for a VCR if you don't already own one. If you'd like to join the Club, send the coupon at the right today or call TOLL-FREE: 1-800-521-0230 (in Michigan, Hawaii or Alaska, phone 1-313-476-8460) between 8 A.M. and 8 P.M., EST, Monday to Friday.

2 for the price of 1.

No obligation ever to buy.
Nothing sent to you unless you order it.

THE VIDEO CLUB OF AMERICA

Dept. PE09, Box D, Madison Heights, Michigan 48071

☐ PLEASE ENROLL ME IN THE VIDEO CLUB OF AMERICA. I understand that this is a no-obligation membership. I will only receive videocassettes I specifically order. By joining now, I will receive a coupon good for a FREE movie or program when I order another of equal or greater value.

☐ Enclosed is my check or money order for \$10.

☐ Please charge my \$10 membership to my credit card:

☐ Master Charge ☐ Visa ☐ American Express ☐ Diners Club ☐ Carte Blanche

Account # _____ Exp. date _____

Signature _____

Name _____

Address _____

City _____ State _____ Zip _____

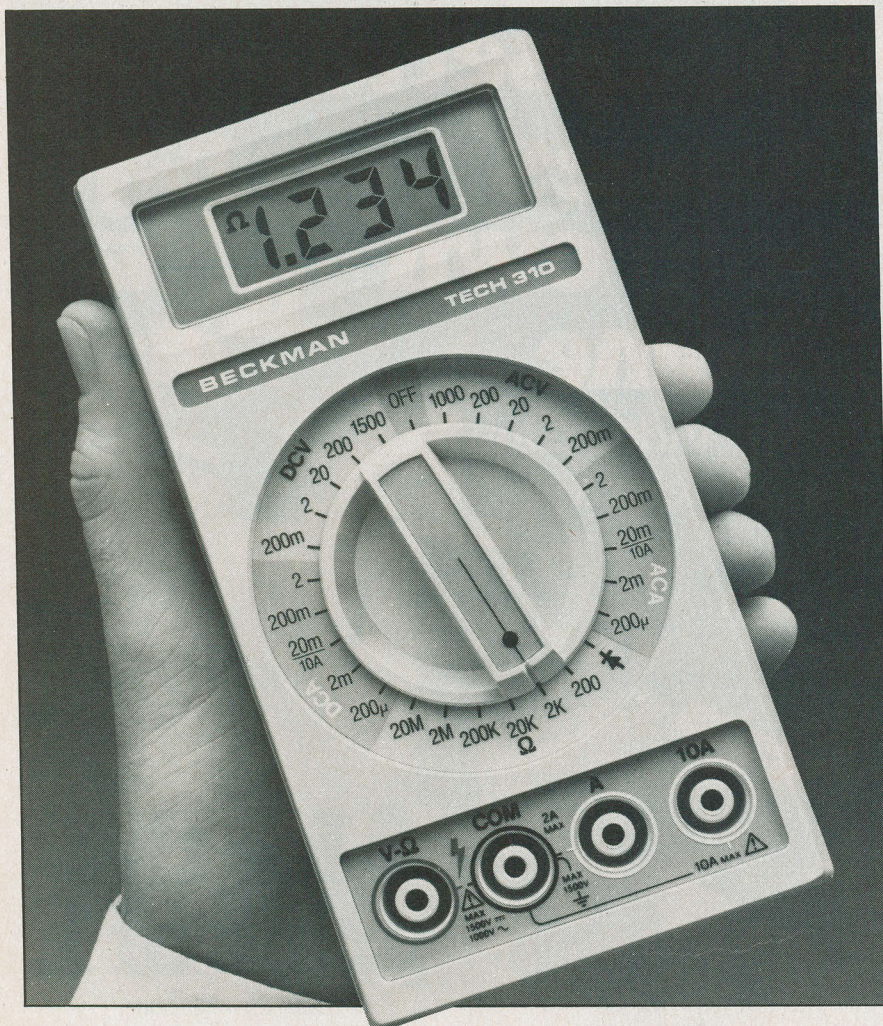
☐ As a member, I'd like to receive a copy of your Equipment Display Sheet.

☐ I do not wish to enroll in the Club now, but I enclose \$1 for your full-color 1980 Program Catalog.

Only one membership per family/household. The Video Club of America reserves the right to reject any application.



\$140 Gets It All.



We just knocked down the last reasons for not going digital in a multimeter. Fast continuity measurement. And price.

Beckman's exclusive Insta-Ohms™ feature lets you do continuity checks as fast as the analogs. And Beckman's superior technology and experience let you own this beauty for such a reasonable price.

Of course you get a lot more. Like 7 functions and 29 ranges including 10 amp ac/dc current capability. 0.25% Vdc accuracy. In-circuit resistance measurements and diode/transistor test function. Two years' typical operation from a common 9-volt battery. In other words, all the features you want in one hand-held unit of exceptional good looks and design.

With 1500 Vdc overload protection, 100% instrument burn-in, plus rugged, impact-resistant case, you're assured of the utmost in dependability and long-term accuracy. You get a tough meter that keeps on going, no matter how tough the going gets.

So visit your dealer today and get your hands on the DMM that does it all. Or call (714) 993-8852 for your nearest distributor.

BECKMAN

CIRCLE NO. 8 ON FREE INFORMATION CARD



What Is the Publishing Schedule?

Your "Microprocessor Applications for the 1980's" series, begun in the May 1980 issue, promises to fill one of my urgent needs. I am very grateful that POPULAR ELECTRONICS has decided to publish such a fundamental and practical training course. But you can imagine my disappointment when neither the June nor the July issue brought the avidly expected continuation of the series. When will future installments appear?—Ernest Thiersch, Orlando, FL.

Future installments will appear irregularly owing to the subject's complex nature and the tender loving care we're taking with them. The next one, due to be published in November, will include a fabulous, inexpensive development board system.—Ed.

What Happened To Safety?

In view of POPULAR ELECTRONICS' usually excellent advice on safety practices, I was surprised to see several defects in the "Varmint Zapper" article (June 1980). First, if connected to a trash can, a HIGH VOLTAGE warning label should be placed on the can. Next, a switch should be provided for the trash collector to turn off the power. Then the can should be placed behind a fence where it won't be accessible to children.

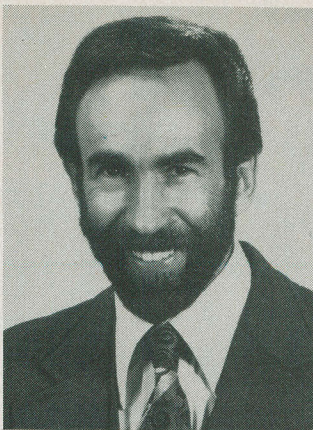
A shock current of up to 50 mA is mentioned. I recall from a PE article of a couple of years ago that 100 mA is generally considered to be lethal to humans. Therefore, shouldn't there be a current-limiting resistor in series with the high-voltage terminal and trash can? Finally, couldn't the short circuit developed when SCR1 conducts possibly damage the SCR, D3, or T1—and possibly S1?—Steve O'Neill, Dixon, CA.

We agree with the safety precautions you list. Note that the Zapper's duty cycle is very low. This being the case, only the instantaneous current might reach 50 mA, but the average current will be only microamperes. Also, the low duty cycle will prevent short-circuit damage to components.—Ed.

A New FM Broadcast Band?

While reading over your August 1980 Editorial, I was surprised to learn that there now exists an FM broadcast band on 88 to 92 kHz. Shouldn't this be 88 to 92 MHz?—Kris Furstman, New York, NY.

You're right, of course. Sorry about the typo.—Ed.



"I made it despite myself."

Success Forces

Can you be successful despite yourself? Here's how I did it.

By Joseph Sugarman, President
JS&A Group, Inc.

It's a joke. I'm considered one of America's top copywriters and mail order entrepreneurs.

I never finished college, never took a course in business, advertising or creative writing, and even flunked English.

On top of that, I failed at almost everything I did. My list of failures would fill an encyclopedia.

Now you probably expect me to tell you that it was failure after failure until I hit upon the "wealth formula" or the "secret to success" or some other trite expression. Not true.

ONLY SIX REASONS

What I've found about success is quite opposite the formulas you've read about or the misconceptions you've heard.

I simply took my few successes and many failures and discovered six reasons why I failed and six reasons why I succeeded.

The reasons I succeeded seemed like forces. Whenever I followed them, I achieved success. Whenever I didn't follow them, I failed. I soon called them Success Forces.

I used Success Forces to build my business from the basement of my home into America's largest single source of space-age products. I was successful. But was it a coincidence or was it a direct result of Success Forces? I really didn't know.

MATERIAL THINGS

If you measure success by material things, I achieved quite a bit: several cars, airplanes, snowmobiles, motorcycles, four beautiful homes—all the material things I imagined I'd ever want.

And I had recognition. My success story was written up in several magazines. But it wasn't until after I revealed my Success Forces in a few speeches that I realized my concept would work for others.

I was getting letters from people who told me how one of my Success Forces had changed their lives. Others told me of how they used Success Forces to make extra money or achieve greater happiness. Still others who always thought of themselves as failures, became successful despite themselves.

But the whole thing seemed strange to me. Was Success Forces original? Something like it had to be in some other success book. So I read. I bought every success book I could find. I studied Chinese philosophy. I bought every motivational cassette that was offered. And I thoroughly studied the material.

I then discovered why my concept was indeed different. Success Forces lets you be yourself, and guides you towards making simple choices that can ultimately change your life. If you make the right choices, you are literally forced into success.

MY \$2,000 SEMINAR

Although I was convinced that my concept was different, I wanted to be absolutely sure it would work. I decided to conduct a seminar with a select group of 16 people who would be willing to pay handsomely to learn my philosophies. My five-day seminar cost each participant \$2,000 and I held eight of them. All were sold out.

The success stories resulting from each seminar are already history. I taught a Texas farmer, a New Zealand rug merchant, a lady from Australia. There were people from all walks of American life, many of whom paid their last \$2,000 to attend.

Not all of the participants succeeded. But so many did become successful and so many told me later how I literally changed their lives, that I was convinced Success Forces should be available for everybody to use.

NOW AVAILABLE

I am now making my concept available in a hardbound book entitled "Success Forces." It contains examples from my speeches and the philosophies from my seminar that participants paid \$2,000 to hear.

A few of the Success Forces you may already know and have been subconsciously following for years. Others, you may have been fighting, thinking that you would fail when all along you would have succeeded. A few of my Success Forces require action—the type of action that everybody can take and that requires no special skill.

This is not a step-by-step book on how to get into a business that promises "A Lazy Way to Riches," or a way to "Quit Your Present Job." It does not matter if you are in business nor whether you want to work hard, take it easy, or just plain be successful.

TEACH HIM TO FISH

There's a saying: "You can feed a man a fish and he'll eat for a day. But teach a man to fish and he'll eat for a lifetime." My book will help you for a lifetime.

I'm not somebody who writes a book on how to make a fortune and then makes my fortune from the sale of the book. I've already made it. Nor am I going to send you a cheaply printed thin paperback. That's not my style. My book is a 200 page hardcover volume that I guarantee you will both enjoy and benefit from. In fact, I will go one step further. After you read it, wait one year. If you have not noticeably benefited from reading Success Forces, return your book to me and I will refund your money in full. Success Forces must give your life additional meaning within one year or your money back. It's that simple. This one-year return offer applies only to those individuals purchasing my book via mail order.

EASY TO ORDER

I've also made it easy for you to order my book. Credit card buyers may call my toll-free number below or send your check or money order for \$9.95 plus \$2.00 postage and handling (Illinois residents please add 6% sales tax) payable to: Joseph Sugarman, Dept. PE, Two JS&A Plaza, Northbrook, Illinois 60062.

I've built my business and reputation on providing solid value to the consumer. Success Forces represents my ultimate product and my greatest value. Order a copy at no obligation, today.

JS&A PRODUCTS
THAT THINK®

Call TOLL-FREE 800 323-6400
In Illinois Call (312) 564-7000

© Joseph Sugarman, 1980



ATARI: PERSONAL COMPUTER

START WITH A BETTER COMPUTER.

Atari personal computers have built-in capabilities you can't even add on to many other personal computers. Three programming formats (slip-in ROM cartridges, disk and cassette). A 57-key upper/lower case ASCII keyboard with 29 keystroke graphics, 128 colors

and hues. Four separate sound channels and a built-in speaker. Four game and graphics controller ports. A built-in RF modulator. FCC approval for connection to any TV. Plus, nationwide Atari Authorized Service Centers. And more.

ADD MEMORY.

The ATARI 800™ comes with 16K of memory. Expand up to a full 48K of memory with 8K or 16K RAM Memory Modules™ you install yourself. In less than a minute. The

ATARI 400™ is supplied with 8K of RAM which can be expanded to 16K at Authorized Service Centers. Both models may be expanded to

26K of ROM with slip-in ROM cartridge programs.

ADD PERIPHERALS.

Atari peripherals are specifically

designed to complement your system. Add the ATARI 410™ Audio-digital Program Recorder. Add disk drives (single or dual double-density*). The ATARI 800 individually accesses up to four drives. Add the ATARI 850™ RS232 Interface Module. Add high-speed 40 or 80-column dot-matrix printers, or, a 40-column thermal printer. Add an acoustic modem for remote data access. Add a light pen.* And there are more Atari peripherals on the way.

ADD PROGRAMS.

Atari's rapidly expanding software library includes some of the most useful, enlightening and entertaining programs available. (Some programs may require more than 16K RAM.)

• **Personal Finance and Record Keeping.** Sophisticated investment analysis programs, including bond analysis, stock analysis, stock charting and mortgage and loan analysis.

*Available Fall, 1980



© 1980, Atari, Inc.

© A Warner Communications Company

Atari reserves the right to make changes to products or programs without notice.



SYSTEMS THAT GROW WITH YOU

- **Personal Interest and Development.** Conversational languages.* Music composition. Touch typing. Biorhythm. And more.
- **Professional Applications.** Graphics, statistics and programmable calculator programs. Plus VisiCalc† the "what if" problem solving program.
- **Education.** ATARI Talk & Teach™ programs offer instruction from primary through college level. Plus, instructive games for all ages.
- **Information & Communication.** Turn your Atari into an interactive terminal. Access stock quotations, news services and other useful data banks. Transmit and receive data over regular phone lines. And more.
- **Entertainment.** Colorful, exciting programs include Star Raiders,™ Chess, Blackjack...and many more.

*Trademark: Personal Software, Inc.

CIRCLE NO. 6 ON FREE INFORMATION CARD

- **Programming Languages.** An ATARI BASIC cartridge is included. An Assembler/Editor Cartridge is available for the advanced programmer. PILOT, extended BASIC and Pascal will be available in 1981.
- **Small Business Accounting.** General Ledger. Accounts Receivable. Accounts Payable. Inventory Control. Order Entry.

ADD IT UP FOR YOURSELF.

Compare the Atari to any personal computer in its price range. Compare built-in features. Compare expandability. Compare peripherals and accessories. Compare programming and formats (ROM

cartridge, disk or cassette). And if you run a business, ask your Atari retailer about the Atari Accountant,™ the complete, computerized accounting system for small businesses. At Atari we're building computer systems you won't outgrow.



PERSONAL COMPUTERS

1265 Borregas Avenue, Sunnyvale, CA 94086

Call toll-free (800) 538-8547 (Except Alaska and Hawaii) In California: (800) 672-1404 for the name of your nearest Atari retailer.

We've got it all together.



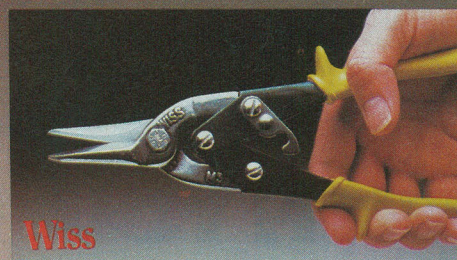
Weller



Weller



Xcelite



Wiss



Nicholson



Boker

**Boker
Crescent
Lufkin
Nicholson
Weller, Wiss
Xcelite**

Take a quick look round this ad and you'll agree that "All together" is no exaggeration. Whether you're making or mending, cutting or joining, measuring or stripping, there's a Cooper tool that's just right for the job. Don't take chances on tools. Specify Cooper and get 'em right the first time!



Lufkin



Crescent



Crescent

from Cooper The Toolmaker.



The Cooper Group

BOKER® CRESCENT® LUFKIN® NICHOLSON® WELLER® WISS® XCELITE®
P.O. Box 728, Apex, North Carolina 27502. Tel: (919) 362-7511. Telex: 579497.

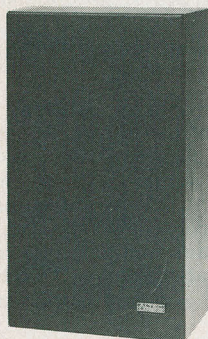
CIRCLE NO. 18 ON FREE INFORMATION CARD



New Products

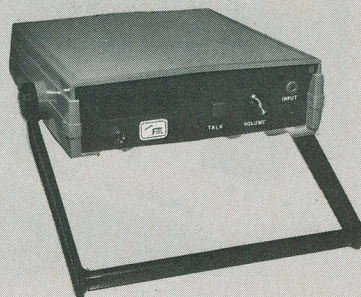
Additional information on new products covered in this section is available from the manufacturers. Either circle the item's code number on the Free Information Card or write to the manufacturer at the address given.

Altec Lansing Speaker System



Altec Lansing's Model 8 speaker system features a 12" woofer, 5" mid-range driver, and for the high end an LZT compression driver, radial phase plug, and constant-directivity Mantaray horn. This 8-ohm-impedance speaker system has a vented enclosure, is designed to handle up to 200 watts of driving power, and is specified to deliver a 92-dB sound-pressure level (SPL). Frequency response is rated at 55 to 20,000 Hz ± 2.5 dB, while dynamic range is rated at 50 dB. Crossover frequencies are at 700 Hz and 5,000 Hz. The cabinet is cov-

Vocal Voltmeter



The Talking Voltmeter, from Franklin Institute Research Laboratory Inc., is a portable 3½-digit (LCD), dc voltmeter that measures from 0-40

volts with a resolution of 0.1 volt. A synthesized voice duplicates the information in the display, allowing the user to keep his eyes on the circuit under test. Audio output is for loud-speaker or earphones. Dual 6500 microprocessors are used, one performing timing and signal processing. A second selects the required speech elements from a ROM. Foreign-language speech, current and resistance measurement add-ons, and a serial interface for recording data on audio cassette are available. Power is from a rechargeable NiCd battery pack. The instrument measures 2.5" \times 10" \times 9" (63 \times 250 \times 225 mm) and weighs 2.5 lb (1.1 kg). \$395.

CIRCLE NO. 88 ON FREE INFORMATION CARD

ered with a lacquered Endriana wood veneer, with a heavy-knit black fabric covering the drivers. Size is 29½" \times 16½" \times 14", and weight is 52 lb.

CIRCLE NO. 86 ON FREE INFORMATION CARD

Realistic Programmable Scanner

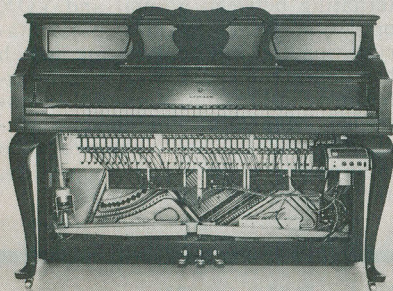


Radio Shack's Realistic Model PRO-2008 direct-entry programmable scanner can directly access 18,600 frequencies (police, fire, ham radio,

etc.) with no need to buy crystals. Desired frequencies are entered via a keyboard, while frequency selections appear in a fluorescent display. Up to eight frequencies from 30 to 50 MHz, 144 to 174 MHz, and 410 to 512 MHz can be entered and scanned at a time. Any channel can be programmed with a scan delay or locked out and skipped when desired. Channels can be scanned automatically or selected manually. Features include: built-in telescoping antenna, jack for external antenna, headphone jack, and reset button that clears all frequencies from the scanner. An optional 9-volt battery prevents loss of programmed frequencies if ac power is interrupted. \$259.95.

CIRCLE NO. 89 ON FREE INFORMATION CARD

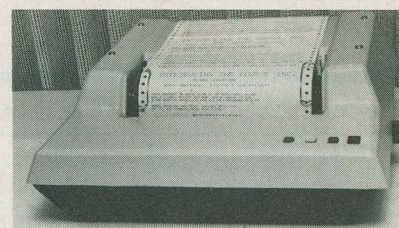
Digital Record/Play Kit for Pianos



"Pianocorder," a do-it-yourself retrofit kit from Superscope, Inc., enables a standard piano to record and play by itself with the touch and interpretation of the recorded pianist. It can be adapted to fit almost any upright, spi-

net, or grand piano without affecting the instrument's normal functioning. Based on computer technology, Pianocorder uses digital tape cassettes to encode and then reenact a performance as it was originally played. Cassettes are inserted in a small tape recorder that activates the piano keys via a logic circuit board mounted across the open space behind the keys. Pre-recorded tapes are also available, including transcribed ones from piano rolls of pianists such as George Gershwin and Scott Joplin. According to Superscope, installation takes 8 to 12 hours. Pianocorder kits start at \$1495.

CIRCLE NO. 87 ON FREE INFORMATION CARD



The 101B-80 Impact Printer Kit from Coosol Inc. is an 80-column, tractor-feed, dot-matrix impact printer that is microprocessor-controlled and programmable with 32 system level commands, graphics, 96 ASCII characters, upper and lower case, and nine software-selectable fonts from 5 \times 7 to 10 \times 14. It features parallel and serial interfaces, baud rate selectable from 110 to 9600, and adjustable tractor width for paper-size selection.

The 101B-80K kit (without enclosure) is \$455; the 101B-80KE (includes enclosure) is \$495. Assembled prices: \$485 and \$545, respectively.

CIRCLE NO. 91 ON FREE INFORMATION CARD

Function Generator



Simpson Electric Co.'s Model 420 Function Generator provides sine, triangle, and square-wave outputs, plus dc and TTL logic-level outputs, over a frequency range from 0.1 Hz to 1 MHz in seven ranges. Signal amplitude is 10 volts peak-to-peak into a 600-ohm load and is continuously variable more than 30 dB. In addition, a fixed attenuator selects 0- or -30-dB attenuation. A continuously variable dc offset is also provided. Frequency accuracy is claimed to be $\pm 3\%$ of full scale from 1 Hz to 100 kHz, with a sine-wave distortion of less than 1% over this range. A special input permits external voltage control of output frequency over a 300:1 ratio. Size is 2.7" \times 8.4" \times 9". Model 420A for ac line operation, \$175; Model 420D line and battery operated, \$210.

CIRCLE NO. 92 ON FREE INFORMATION CARD

8000-Baud TRS-80 Cassette Interface

The FCI-80 Fastload Cassette Interface from Microsette plugs into the rear of a TRS-80 Level II, 16K keyboard, or expansion interface to allow the cassette port to operate at 8000

Fisher AM/FM-Stereo Receiver



Fisher's Model RS270 AM/FM-stereo receiver teams a Class-A-II amplifier with a quartz-controlled PLL digitally synthesized tuning system. The amplifier section is rated at 50 watts/channel rms into 8 ohms from 20 to 20,000 Hz with no more than 0.02%

Heathkit Portable Engine Analyzer



The Model CM-1550 is a new portable engine analyzer in kit form from Heath. It is designed to handle several

baud—16 times faster than normal. Included is a LED display for proper level settings, and a search capability that allows searching for BASIC programs having names from one to six letters long. Using a modified CTR-41 recorder, programs can be loaded at about one second per kilobyte. The system also can be called from Disk BASIC. \$199.

CIRCLE NO. 93 ON FREE INFORMATION CARD

President Mobile AM CB Transceiver

Designated the President Model AR 711, the new mobile AM CB transceiver from American Radio Corp. is said to have been designed to the specifications of truckers and other professional users. It features a noise-cancelling microphone with 10' coil cord, 4" external speaker with mounting bracket and 5' cable, instant-select channels 9 and 19 switches, and a HI-CUT tone switch. Other features in-

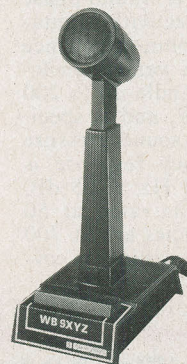
tuneup measurements, including dwell for 4- through 8-cylinder engines, rpm to 10,000 in two ranges, and direct current to 20 amperes. With an optional CMA-1550-1 shunt accessory, the analyzer can also measure starting current and battery charging/discharging current up to 400 amperes. A large liquid-crystal display gives numerical values of all measurements. Heath claims the kit can be assembled in two or three evenings, with only one circuit board to be wired. Calibration is accomplished from internal references. \$94.95 for analyzer kit, \$13.95 for optional shunt accessory.

CIRCLE NO. 90 ON FREE INFORMATION CARD

clude: microphone, squelch, volume, and r-f controls; automatic noise-limiter/noise-blanker switch; S/r-f meter; digital numeric channel indicator; transmit and receive indicators; positive/negative grounding system; automatic modulation control; and PA and external-speaker jacks. \$139.95.

CIRCLE NO. 94 ON FREE INFORMATION CARD

Shure Communications Microphone



Shure's Model 444D communications microphone retains all the performance characteristics of the previous Model 444, but has added features for ham-radio operators. Among these is a switch that allows selection of either high- or low-impedance operation. A second switch permits alternating between normal and VOX operation. Other features: momentary-action/locking push-to-talk switch bar that actuates the mike and an external relay or control circuit; "Controlled Magnetic" microphone element whose response is claimed to be tailored for maximum intelligibility; and height adjustment. \$55.50.

CIRCLE NO. 96 ON FREE INFORMATION CARD

True RMS DMM

Besides the conventional voltage, current, and resistance ranges, Beckman's hand-held Tech 330 3 1/2-digit multimeter features true rms (ac +

(Continued on page 14)

Six new Scanners! New 800 MHz!

Communications Electronics™, the world's largest distributor of radio scanners, welcomes the addition of Fanon to our product line. Fanon introduces two new high performance hand-held scanners. More importantly, Fanon has a complete selection of useful accessories to compliment their *Slimline* models.

Electra Company, manufacturers of *Bearcat* brand scanners introduces three new scanners including a model that can monitor the exciting 800 MHz. band. The new *Bearcat* models will be available Fall, 1980, so reserve your scanner now!

A new product made by Electra, the *Freedom Phone*® is now available from CE. This is the ultimate cordless extension phone that can make and take your calls.

Bearcat® 300

The Ultimate Synthesized Scanner!

Allow 90-120 days for delivery after receipt of order due to the high demand for this product. List price \$519.95/CE price \$339.00

4-Band, 50 Channel • Service Search • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC Bands: 32-50, 118-136 AM, 144-174, 421-512 MHz. The new *Bearcat* 300 is the most advanced automatic scanning radio that has ever been offered to the public. The *Bearcat* 300 uses a bright green fluorescent digital display, so it's ideal for mobile applications. The *Bearcat* 300 now has these added features: Service Search, Display Intensity Control, Hold Search and Resume Search keys, Separate Band keys to permit lock-in/lock-out of any band for more efficient service search.

Bearcat® 250

List price \$419.95/CE price \$279.00

50 Channels • Crystalless • Searches Stores • Recalls • Digital clock • AC/DC Priority Channel • 3-Band • Count Feature.

Frequency range 32-50, 146-174, 420-512 MHz. The *Bearcat* 250 performs any scanning function you could possibly want. With push button ease you can program up to 50 channels for automatic monitoring.

Bearcat® 220

List price \$419.95/CE price \$279.00

Aircraft and public service monitor. Frequency range 32-50, 118-136 AM, 144-174, 420-512 MHz.

The *Bearcat* 220 is one scanner which can monitor all public service bands plus the exciting AM aircraft band channels. Up to twenty frequencies may be scanned at the same time.

Bearcat® 211

List price \$349.95/CE price \$229.00

Frequency range: 32-50, 146-174, 420-512 MHz. The *Bearcat* 211. It's an evolutionary explosion of features and function. 18-channel monitoring. With no-crystal three-band coverage. Dual scan speeds. Color-coded keyboard. Even a digital clock. All at a modest price. More scanning excitement than you bargained for.

NEW! Bearcat® 210XL

This is a new model. Shipments will begin in Fall, 1980. List price \$319.95/CE price \$219.00

18 Channels • 3 Bands • Crystalless Frequency range: 32-50, 144-174, 421-512 MHz. The *Bearcat* 210XL scanning radio is the second generation of the world's best selling crystalless programmable scanner—the *Bearcat* 210. It has almost twice the scanning capacity with 18 channels plus dual scanning speeds and a bright green fluorescent display.



NEW! Bearcat 160

Bearcat® 210

List price \$319.95/CE price \$209.00

10 Channels • 3 Bands • Crystalless

Frequency range: 32-50, 146-174, 420-512 MHz. Use the simple keyboard to select the 10 channels to be scanned. Automatic search finds new frequencies. The 210 features patented selectable scan delay, push button lockout, single antenna, patented track tuning, AC/DC operation. With no crystals to buy. Ever!

NEW! Bearcat® 160

This is a new model. Shipments will begin in Fall, 1980. List price \$279.95/CE price \$199.00

16 Channels • 3 Bands • AC only • Priority

Dual Scan Speeds • Direct Channel Access

Frequency range: 32-40, 144-174, 440-512 MHz.

The *Bearcat* 160 presents a new dimension in scanning form and function. The keyboard is smooth. No buttons to punch. No knobs to turn. Instead, finger-tip pads provide control of all scanning operations, including On/Off, Volume and Squelch. Green easy to read fluorescent display. Requires (2) 9 Volt batteries to retain memory when disconnected from AC Power.

Bearcat® 12

List price \$179.95/CE price \$119.00

10 Crystal Channels • 3 Bands • AC or DC

Frequency range: 33-48, 146-174, 450-512 MHz.

More features, more channels, more action. The *Bearcat* 12 has automatic squelch, individual lockout and more.

NEW! Bearcat® 5/800 MHz

The world's first 800 MHz. scanner!

This is a new model. Shipments will begin in Fall, 1980. List price \$179.95/CE price \$129.00

8 Crystal Channels • 4 Bands • AC only

Frequency range: 33-50, 144-174, 440-512, 806-870 MHz.

The *Bearcat* 5/800 MHz is the only scanner on the market today that offers coverage of the 800 MHz. public service band and the other public service bands. Individual channel lockout. Scan Delay. Manual Scan.

Bearcat® 5

List price \$129.95/CE price \$94.00

8 Crystal Channels • 3 Bands • AC only

Frequency range: 33-50, 146-174, 450-508 MHz.

The *Bearcat* 5 is a value-packed crystal scanner built for the scanning professional — at a price the first-time buyer can afford. Individual lockout switches.

Bearcat® Four-Six ThinScan™

List price \$179.95/CE price \$119.00

Frequency range: 33-47, 152-164, 450-508 MHz.

The incredible, new *Bearcat* Four-Six Thin Scan™ is like having an information center in your pocket. This three band, 6 channel crystal controlled scanner has patented Track Tuning on UHF. Scan Delay and Channel Lockout. Measures 2 3/4 x 6 1/4 x 1 1/2. Includes rubber ducky antenna.

NEW! Fanon Slimline 6-HLU

List price \$169.95/CE price \$109.00

Low cost 6-channel, 3-band scanner!

The new Fanon Slimline 6-HLU gives you six channels of crystal controlled excitement. Unique Automatic Peak Tuning Circuit adjusts the receiver front end for maximum sensitivity across the entire UHF band. Individual channel lockout switches. Frequency range 30-50, 146-175 and 450-512 MHz. Size 2 3/4 x 6 1/4 x 1 1/2. Includes rubber ducky antenna. Order crystals for each channel.

NEW! Fanon Slimline 6-HL

List price \$149.95/CE price \$99.00

6-Channel performance at 4-channel cost!

Frequency range: 30-50, 146-175 MHz.

If you don't need the UHF band, get this model and save money. Same high performance and features as the model HLU without the UHF band. Order crystal certificates for each channel.

FANON SCANNER ACCESSORIES

CHB-6 AC Adapter/Battery Charger \$15.00
CAT-6 Carrying case for Fanon w/Belt Clip \$15.00
AUC-3 Auto lighter adaptor/Battery Charger \$15.00

OTHER SCANNER ACCESSORIES

SP50 AC Adapter \$12.00
SP51 Battery Charger \$12.00
SP58 Carrying Case for *Bearcat* 4-6 ThinScan™ \$15.00
FB-E Frequency Directory for Eastern U.S.A. \$15.00
FB-W Frequency Directory for Western U.S.A. \$15.00
FFD Federal Frequency Directory for U.S.A. \$18.00
SM220 Service manual for *Bearcat* 220 \$15.00
B-4 1.2 V AAA Ni-Cad's for ThinScan™ and Fanon \$15.00
B-5 Replacement memory battery for *Bearcat* 210 \$6.00
B-7 1.5 V AAA Alkaline battery (Pack of 4) \$4.00
B-9 9 V Alkaline battery \$3.00
A-135cc Crystal certificate \$4.00
Add \$3.00 shipping for all accessories ordered at the same time.

INCREASED PERFORMANCE ANTENNAS

If you want the utmost in performance from your scanner, it is essential that you use an external antenna. We have six base and mobile antennas specifically designed for receiving all bands. Order #A60 is a magnet mount mobile antenna. Order #A61 is a gutter clip mobile antenna. Order #A62 is a trunk-lip mobile antenna. Order #A63 is a 3/4 inch hole mount. Order #A64 is a 3/8 inch snap-in mount, and #A70 is an all band base station antenna. All antennas are \$30.00 and \$3.00 for UPS shipping in the continental United States.

TEST ANY SCANNER FREE

Test any scanner purchased from Communications Electronics™ for 31 days before you decide to keep it. If for any reason you are not completely satisfied, return it in original condition with all parts in 31 days, for a prompt refund (less shipping/handling charges and rebate credits).

CIRCLE NO. 1 ON FREE INFORMATION CARD

NEW! Regency® M400

List price \$379.95/CE price \$259.00

30 Channel • Synthesized • Service Search

Digital clock • Digital timer • M100 styling

Search/Store • Priority Channel • AC/DC

Frequency range: 30-50, 144-174, 440-512 MHz.

The new *Regency* M400 is a compact programmable FM monitor receiver for use at home or on the road.

OTHER REGENCY® SCANNERS

Aircraft Touch 720-A \$229.00
Touch K100 \$199.00
Touch M100 \$199.00

NEW! Telephone Products

Electra's cordless *Freedom Phone* does everything an ordinary phone does and more. Because it is cordless, you can take it anywhere, inside or outside—the patio, by the pool, in the garage, in the workshop...even next door at the neighbor's.

Model FF-500 has pushbutton dialing. Rechargeable ni-cad batteries included. Battery low light. Secure feature. Telescopic antenna. Your cost is \$179.00. Model FF-1500 has the same features as the FF-500 but also includes a charger/cradle that allows the phone's handset to be recharged away from the base station. Your cost for this cordless phone is \$199.00. The model FF-3000 has all the standard features (except charger/cradle) plus interchangeable telescopic and rubber ducky antenna. Redial feature. Belt clip. Carrying case. Greater range. Your cost is \$229.00.

World Scanner Association™

The WORLD SCANNER ASSOCIATION is sponsored as a public service by Communications Electronics™. When you join, you'll receive a quarterly newsletter with scanner news and features. You'll also get a wallet I.D. card, an Official WSA Membership Certificate, and more. FREE classified ads for members so you can contact other scanner owners when you want to sell or buy a scanner. FREE membership in the WSA Buyer's Co-op. Your Co-op membership will allow you to get special discounts on scanners and scanner related products. Since the WSA Buyer's Co-op gives you group purchasing power, you can easily pay for your membership dues the first time you make a Co-op purchase. To join, send \$12.00 (\$17.00 outside U.S.A.) for your membership materials.

BUY WITH CONFIDENCE

To get the fastest delivery from CE of any scanner, send or phone your order directly to our Scanner Distribution Center™. Be sure to calculate your price using the CE prices in this ad. Michigan residents please add 4% sales tax. Written purchase orders are accepted from approved government agencies and most well rated firms at a 10% surcharge for net 30 billing. All sales are subject to availability. All sales on accessories are final. Prices and specifications are subject to change without notice. Out of stock items will be placed on backorder automatically unless CE is instructed differently. International orders are invited with a \$10.00 surcharge for special handling in addition to shipping charges. All shipments are F.O.B. Ann Arbor, Michigan. No COD's please. Non-certified and foreign checks require four weeks bank clearance.

Mail orders to: Communications Electronics™, Box 1002, Ann Arbor, Michigan 48106 U.S.A. Add \$6.00 per scanner or phone product for U.P.S. ground shipping, or \$12.00 for faster U.P.S. air shipping to some locations. If you have a Master Charge or Visa card, you may call anytime and place a credit card order. Order toll free in the U.S.A. 800-521-4414. If you are outside the U.S. or in Michigan, dial 313-994-4444. Dealer inquiries invited. All order lines at Communications Electronics™ are staffed 24 hours.

WSA™, Scanner Distribution Center™ and CE logos are trademarks of Communications Electronics™.

† *Bearcat* and *Freedom Phone* are federally registered trademarks of Electra Company, a Division of Masco Corporation of Indiana.

‡ *Regency* is a federally registered trademark of Regency Electronics Inc.

Copyright ©1980 Communications Electronics™



COMMUNICATIONS ELECTRONICS™

854 Phoenix □ Box 1002 □ Ann Arbor, Michigan 48106 U.S.A.
Call TOLL-FREE (800) 521-4414 or outside U.S.A. (313) 994-4444

We're first with the best.™

Crown makes American high-technology audio components, whose innovative designs and remarkable specifications established new performance standards for an entire industry. Crown amps, pre-amps, crossovers, equalizers and tuners are highly respected by audio enthusiasts. Performers, recording engineers and sound contractors choose Crown for their personal, and professional systems.

The Crown Information Package tells all about Crown and its products, possibly the finest collection of audio information easily available to you. Over 50 pages, including Crown technical papers on audio concepts, discussions

Buy Crown. Four dollars.

of product design and operation, specifications, prices, dealer locations – and much more. Many illustrations in full color.

Send four dollars with the coupon. If it's not worth it, send it right back. We'll refund your money.

If all you need is the name of a nearby Crown dealer (he has this information for free), use our reader service card number.

Here's my \$4. Send the package.

Name _____

Address _____

City _____

State _____ Zip _____

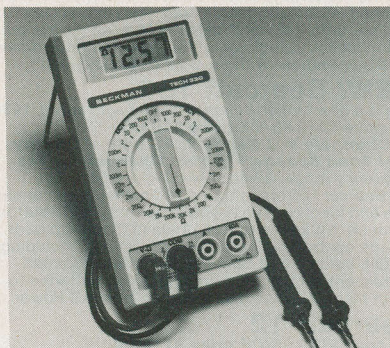


1718 W. Mishawaka Rd, Elkhart, IN 46514

Innovation. High technology. American. That's Crown.

CIRCLE NO. 79 ON FREE INFORMATION CARD

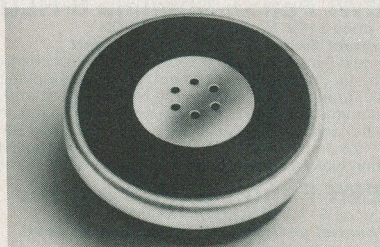
new products



dc) measurement capability, 10-ampere current ranges, a built-in continuity indicator, complete r-f shielding, and an LCD display. Claimed dc accuracy is 0.1% with a 22-megohm input resistance. True rms capability allows more accurate measurement of nonsinusoidal waveforms such as found in switching power supplies, motor-speed controllers, SCR regulators, and digital systems. Ac measuring accuracy is from $\pm 0.6\%$ of reading at 45 Hz to $\pm 2\%$ of reading at 20 kHz. Ac voltage ranges have the claimed accuracy to 20 kHz for signals having a crest factor (peak/rms) from 1:1 to 5:1. \$200.

CIRCLE NO. 97 ON FREE INFORMATION CARD

"Supermike" for Phones



Novation Inc.'s Supermike is an FCC-approved condenser microphone that replaces the conventional carbon microphone element in telephone handsets. It is claimed that this new element reduces second harmonic generation by over 40 dB, improving data transmission clarity up to five times when an acoustic coupler is used. The microphone contains a solid-state preamplifier powered from the telephone circuit. It is said to maintain constant line levels and improve signal-to-noise ratio in all acoustic-type communications. \$9.95.

CIRCLE NO. 98 ON FREE INFORMATION CARD

Color Receiver/Monitor

A new color-TV receiver/video monitor with integrated-circuit design, quick-start black-matrix in-line picture tube, automatic fine tuning (aft), and automatic gain control (agc) is available from V.A.M.P. Inc. The 13" diagonal Model VM-1300 can be

switched from standard vhf/uhf TV reception to the video-monitor mode by flipping a toggle. In the monitor mode, it accepts standard video. Looping inputs, with switchable 75-ohm termination, are provided to permit linking of multiple monitors. An audio input is also provided. Resolution in the monitor mode is 300 lines horizontal by 350 lines vertical. Price is \$449. (A 19" version, the Model VM-1900, is also available for \$575.) Address: V.A.M.P. Inc., 1617 El Centro Ave., Los Angeles, CA 90028.

Hi-Fi Component Credenza



A credenza with 1 1/2"-thick sides and divided into two sections, each with three shelves behind bronze-toned safety glass doors, has been introduced by Gusdorf Corp. The upper surface is surrounded, sides and back, by a gallery and is wide enough to accommodate a TV receiver, turntable, or videocassette recorder. Amplifiers, tuners, preamps, tape decks, etc., fit inside the credenza. Record dividers come with the credenza, while a rack-mounting kit is optional. The furniture-grade double-wheeled casters are hooded. The credenza's sides and top are finished in a walnut tone, with additional protection of a Rendura coating. \$280.

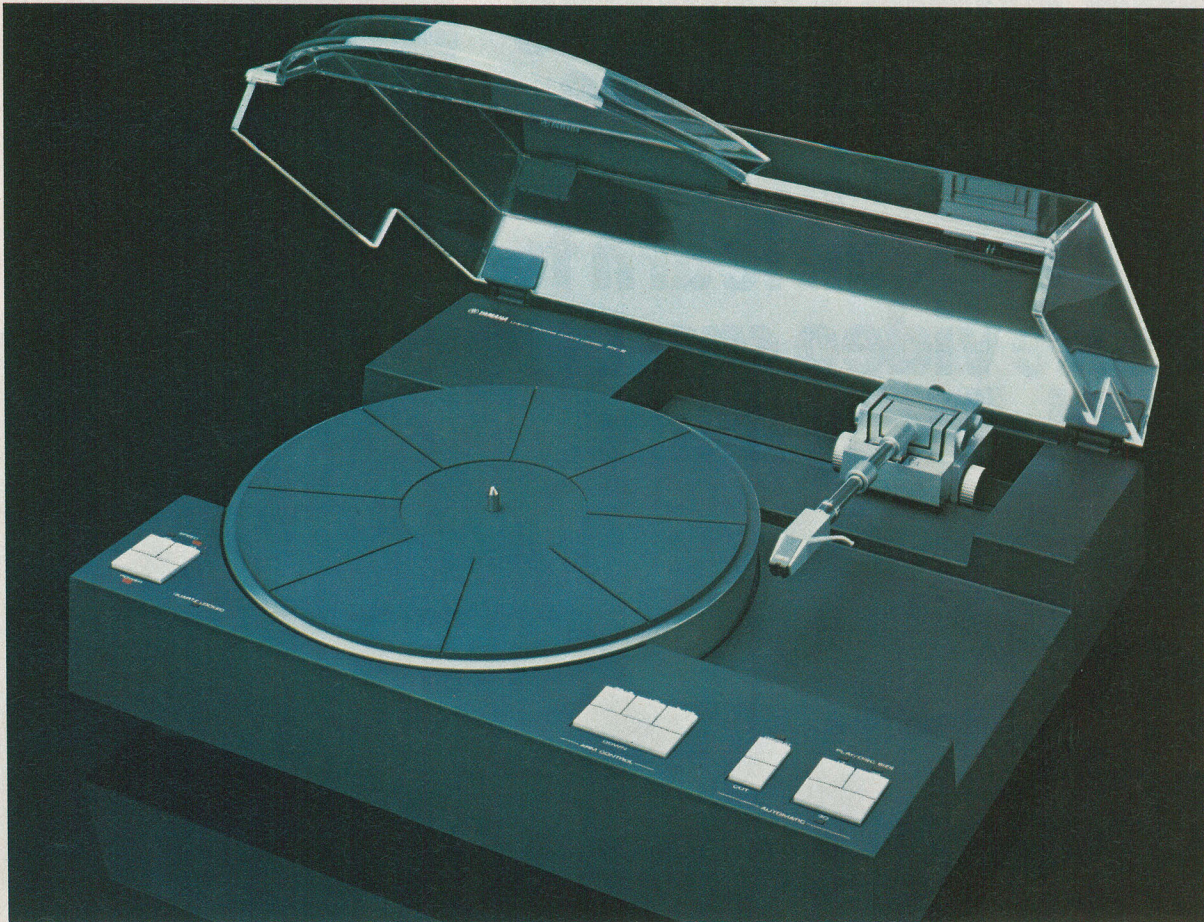
CIRCLE NO. 99 ON FREE INFORMATION CARD

Cushcraft Triband Amateur Beam

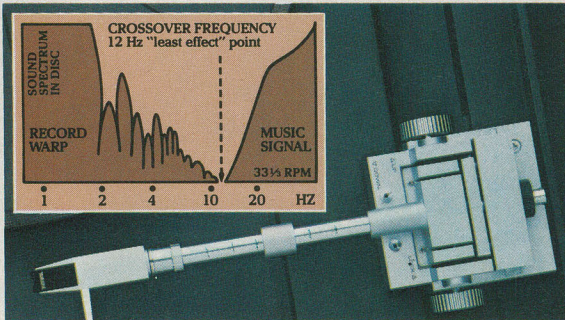
Cushcraft's Model A3 is a lightweight, compact Yagi array designed for use on 20, 15 and 10 meters. It has a rated forward gain of 8 dB and an average front-to-back ratio of 25 dB. Nominal feedpoint impedance is 50 ohms unbalanced, (1.2:1 VSWR), average usable bandwidth (VSWR 2:1 or less) is 500 kHz, and rated power-handling capacity is 2000 watts PEP. The antenna weighs 35 lb (15.9 kg), is made of swaged seamless aluminum tubing and G-10 fiberglass, and uses stainless and zinc-plated steel hardware. Tapered tube elements are employed to minimize wind loading and surface area, which is rated at 5.6 ft² (0.5 m²). Turning radius is 15.5 ft (4.8 m). \$199.95.

CIRCLE NO. 100 ON FREE INFORMATION CARD

Yamaha's PX-2 linear tracking turntable. A class of one.



Yamaha's new PX-2, the flagship of a remarkable new series of turntables from Yamaha, is destined to become the new standard of the audio industry. It is a masterpiece in the art of music reproduction. Totally in a class by itself.



One of the major performance advancements on the PX-2 is Yamaha's unique optimum mass straight tonearm assembly. This design concept is Yamaha's direct challenge to the industry trend of low-mass tonearms. Among the most significant benefits of optimum mass is that it specifically addresses two of the most critical elements of music signal tonal quality—tonearm resonant frequency characteristics and high trackability with a wide range of cartridges. Tonearm mass is such a critical element in sound reproduction (especially in the low and high frequency ranges) that Yamaha has designed this optimum mass tonearm to insure its resonance frequency is at the "least effect" point. (See graph.) As a further benefit, the vast majority of available cartridges can be effectively

matched with the Yamaha tonearm. Even MC types.

But the optimum mass tonearm is only one factor that puts the PX-2 in a class by itself. There's much more. Like an extraordinary 80dB S/N ratio, with incredibly accurate tangential tracking—constantly monitored by an opto-electronic sensor. The PX-2 is also a study in durability with its solid, anti-resonant monolithic diecast aluminum base. And the combined effect of the hefty platter and the heavy-duty DC motor depresses wow and flutter to below 0.01%.

Yet with all this performance, the PX-2 is deceptively easy to operate. All the microprocessor-activated controls are easily accessible—without lifting the dustcover.

The balance of the turntables in our new line (the P-750,



P-550, P-450 and P-350) all incorporate this same optimum mass tonearm philosophy. Each will set new standards for performance per dollar invested.

Visit your local Yamaha Audio Specialty Dealer for a personal test of our remarkable

PX-2 and the other superb turntables in our new series. You'll hear music that's truly in a class by itself.

For more information write us at Yamaha, Audio Division, P.O. Box 6600, Buena Park, CA 90622.

*Yamaha cartridges shown (MC-1X and MC-7) on both models are optional.



**NRI training in TV
and Audio Servicing
keeps up with the
state of the art.
Now you can learn to
service video cassette
and disc systems.**





You build color TV, hi-fi, professional instruments.

Now, in addition to learning color TV and audio systems servicing, you get state-of-the-art lessons in maintaining and repairing video cassette recorders, and the amazing new video disc players, both mechanical and laser-beam types.

Learn at Home in Your Spare Time

And you learn right at home, at your own convenience, without quitting your job or going to night school. NRI "bite-size" lessons make learning easier...NRI "hands-on" training gives you practical bench experience as you progress. You not only get theory, you actually build and test electronic circuits, a complete audio system, even a color TV.

Build Color TV with Computer Programming

As part of your training in NRI's Master Course in TV/Audio/Video Systems Servicing, you actually assemble and keep NRI's exclusive designed-for-learning 25"

(diagonal) color TV. It's the only one that comes complete with built-in computer tuning that lets you program an entire evening's entertainment. As you build it, you introduce and correct electronic faults, study circuit operation, get practical bench experience that gives you extra confidence.

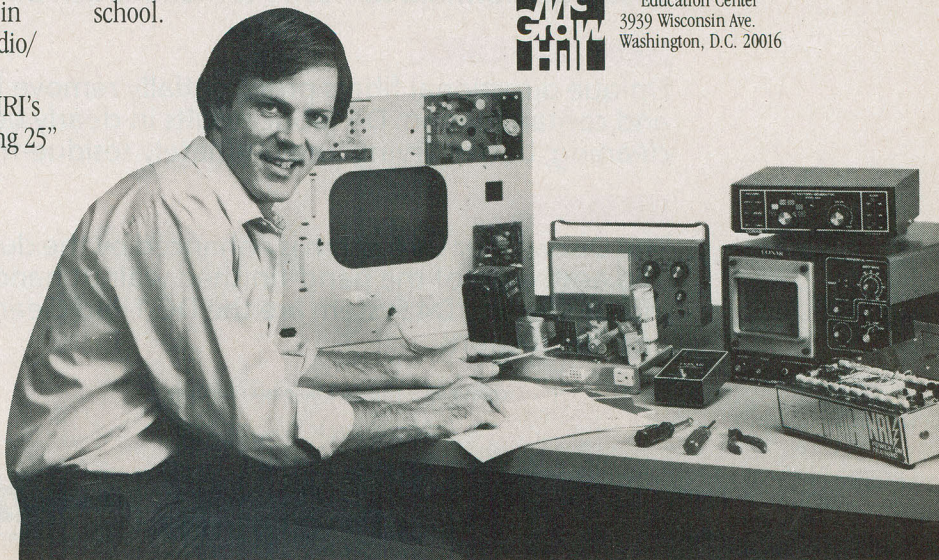
You also construct a solid-state stereo tuner and amplifier complete with speakers. You even assemble professional-grade test instruments so you know what makes them tick, too. Then you use them in your course, keep them for actual TV and audio servicing work.

NRI Includes the Instruments You Need

You start by building a transistorized volt-ohm meter which you use for basic training in electronic theory. Then you assemble a digital CMOS frequency counter for use with lessons in analog and digital circuitry, FM principles. You also get an integrated circuit TV pattern generator, and an advanced design solid-state 5" triggered-sweep oscilloscope. Use them for learning, then use them for earning.

NRI Training Works... Choice of the Pros

More than 60 years and a million students later, NRI is still first choice in home study schools. A national survey of successful TV repairmen shows that more than half have had home study training, and among them, it's NRI 3 to 1 over any other school.



Learn at home at your convenience.

(Summary of survey on request.)

That's because you can't beat the training and you can't beat the value! For hundreds of dollars less than competing schools, NRI gives you *both* color TV and audio...



Other NRI training includes Computer Technology, Complete Communications Electronics.

and now includes training in video cassette and disc systems. Send for our free catalog and see for yourself why NRI works for you.

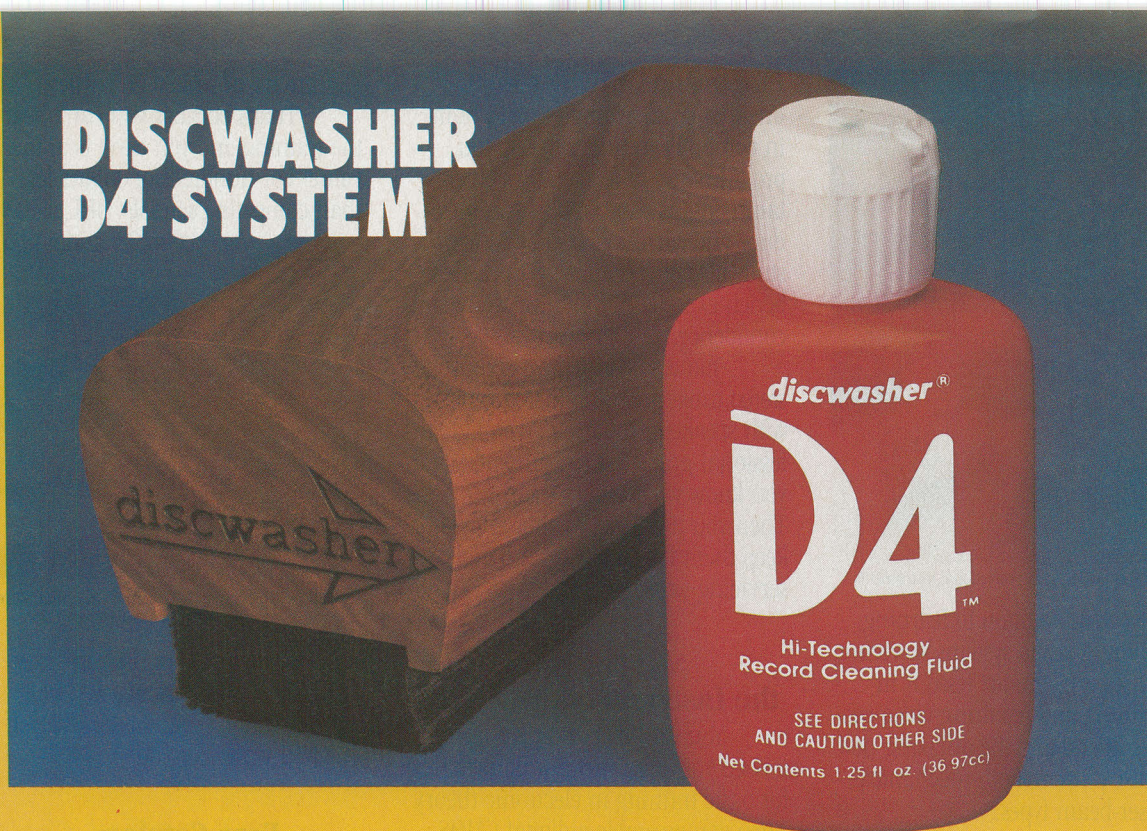
Free Catalog... No Salesman Will Call

Send today for our free 100-page catalog which shows all the kits and equipment, complete lesson plans, and convenient time payment plans for courses to fit your needs and budget. Or explore the opportunities in other NRI home study courses like Microcomputers & Microprocessors, CB and Mobile Radio, Aircraft and Marine Radio or Complete Communications. Send the postage-paid card today and get a head start on the state of the art. If card has been removed, write to:



NRI Schools
McGraw-Hill Continuing
Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016

DISCWASHER D4 SYSTEM



A NEW STANDARD OF RECORD CARE

NEW D4 FLUID

Inherently more active against record contamination.
Inherently safe for record vinyl. Preferentially
absorptive formula carries all contamination off the record.

NEW D4 FABRIC

Unique directional fibers preferentially remove fluid
and contamination. D4 fabric results in clearly better
cleaning, better drying and ultimately residue-free surfaces.

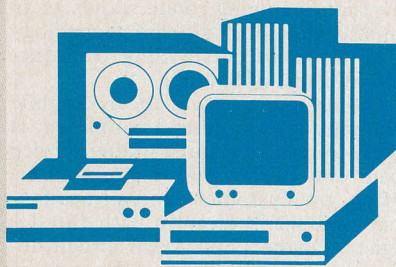
UNMATCHED VALUE

The Discwasher D4 System is enhanced by the durability
and aesthetics of the hand-finished walnut handle.
Included in the D4 System are the DC-1 Pad Cleaner and
new instructions.

CIRCLE NO. 23 ON FREE INFORMATION CARD

discwasher®
PRODUCTS TO CARE FOR YOUR MUSIC

Discwasher, Inc., 1407 N. Providence Rd., Columbia, MO 65201



Entertainment Electronics

By Laurence Greenhill

High-End Audio

CONTRARY to the continuing trend of inflation in the 1970s and '80s, the electronics industry has been able to produce calculators, television games, home computers, digital watches, and audio equipment at prices that have remained relatively stable or, in some cases, fallen. This fortunate state of affairs is very likely a result of parts and manufacturing economies gained by using large-volume-production and integrated circuits. The net effect is to give the consumer better value for his money.

In contrast to this, there is a small group of U.S. manufacturers that design and market exquisitely crafted, high-quality stereo components; and their prices have shown an upward trend with time. These so-called high-end companies normally limit their business to separate components and show little interest in receivers and integrated amplifiers. Their products are developed by modifying the basic design of a unit every few years. Production output is generally small, often as little as a few pieces per week, and is sold through a small network of carefully selected retail stores. Mark Levinson Audio Systems, Ltd., Threshold Corporation, and Audio Research are good examples of such "high-end" audio companies.

The high price of equipment sold by these companies clearly sets it apart from the industry mainstream. Let's contrast two different design approaches—a cost-sparing one by Carver Corporation and a "price-no-object" one by Threshold Corporation. Both products, the Carver M-400 and the Threshold Stasis 1, are basic power amplifiers capable of supplying 200 watts per channel, but at that point the similarity between them seems to end. Where Carver supplies two channels of amplification for \$350, Threshold equipment to do the same job (two mono amplifiers) will set you back a whopping \$7,000! Where Carver has built on the current trend to switching power supplies and variable supply voltage to the output stage in an effort to save weight, space, and power dissipation, Threshold has developed a unique circuit that forces active devices in the output stage to operate in a way that is inherently errorless.

Nelson Pass of Threshold believes that dynamic amplifier distortion can be reduced greatly if an amplifier stage runs with nearly constant voltage and constant current across and through the active device. His original 1978 patent for the Stasis 1 achieved this by connecting two amplifiers. A small, low-impedance, constant-voltage, cascoded, class-A amplifier (the "Stasis" section) feeds low current through the load (the speaker) to a second, high-impedance, high-power, class-AB amplifier of constant current (the current "mirror"). The low impedance of the first, low-power, very-high-quality Stasis amplifier causes it to dominate and to determine the speaker response's sonic quality. The second amplifier, outside of the feedback loop of the Stasis section, serves as a current bootstrap and carries out most of the work through the speaker. Open-loop distortion can be reduced 10 to 30 times, so that no overall system feedback between amplifiers is required. Pass's Stasis design resembles Peter Walker's "current dumping" Quad 405 amplifier, but the Threshold amp does not utilize the 405's impedance bridge to connect the small, superb amplifier to the "large" current source.

To continue the comparison, the Carver weighs 4.5 lb per channel; the Threshold weighs in at 100 lb. Limiters in the Carver hold current flow to 15 amperes; the Threshold will pass pulses of 30 amperes. For other features of the two amplifiers, let's look at their general descriptions, as follows.

Carver M-400 Power Amplifier. Features magnetic-field circuitry that eliminates need for oversized heat sinks, power transformers, and electrolytic capacitors; dual moving-LED vertical-peak level display with VU ballistics; 200 W/ch continuous into 8 ohms from 1 to 20,000 Hz with 0.05% THD and 0.06% IM distortion; frequency response, 1 to 250,000 Hz ± 0.25 dB; S/N, 100 dB (A-weighted); slew rate, 80 V/ μ s; dynamic range, 50 dB. Brushed champagne gold finish with brown trim; 6 $\frac{3}{4}$ " H \times 6 $\frac{3}{4}$ " W \times 6 $\frac{3}{4}$ " D.

Threshold Stasis 1 Power Amplifier. Mono power amplifier features constant-current/constant-voltage operating system designed to eliminate semiconductor distortion; 72 ultra-high-speed output transistors; adjustable peak and average meter output display with sensitivity readings of peak/average 0 dB at 15 W, 8 ohms and peak/average 0 dB at 150 W, 8 ohms; LED indicators for amp on, error waveform, over temperature, and standby. Dimensions of the Stasis 1, which is rack mountable, are 19 $\frac{5}{8}$ " W \times 8 $\frac{3}{4}$ " H \times 19" D.

Unlike the Carver amplifier, whose manufacturer limits its application to the home environment, the Stasis 1 can be used for sound reinforcement, by rock groups, or even to drive highly reactive loads represented by cutter heads used in making disc records. Jack Renner of Telarc Records, for example, has used the Stasis 1 to cut lacquers. The monophonic Stasis 1 will also serve as the "flagship" for Threshold's new line of stereo Stasis amplifiers, the 200 watt-per-channel Stasis 2 (\$2,450) and the 100 watt-per-channel Stasis 3 (\$1,675).

Why would one buy a Stasis 1? Nelson Pass believes that the unique sonic excellence of the Stasis 1 is easily discernable, although its standard distortion figures are no different than those of the Carver. Obviously, the customer considering a Stasis 1 must weigh other factors besides pure performance. Let's examine the elements of such a choice.

Is Price the Main Specification?

Purchasing audio equipment can be a great conundrum to the consumer. Excellence abounds in all price categories. Distortion specifications of most midprice separate components match the lower limits of the average test equipment. Since these specifications cannot readily improve, manufacturers set their products apart by stressing appearance, massiveness, ruggedness, quality of individual parts, and complexity of circuit design. As a result, brochures on high-end equipment may offer no numerical specifications. Instead, they focus on chassis construction, design of the output circuit, the number of power output devices, and weight and design of the power supply. Thus, the prospective purchaser may become involved with the product's construction, nameplate engraving, and the degree to which inner parts are over-designed or derated, more than the product's function of amplifying an audio signal. In a sense, it is as if the audiophile were purchasing an elegant metal sculpture. Often the only available numerical specification, besides power output, is price. It may be that, like many glamorous consumer items, some high-end audio compo-

nents stress high price to emphasize exclusiveness and quality.

Why does the prospective customer consider purchasing a "super-priced" audio product? Although these devices are touted as delivering the ultimate in sonic quality, lab tests on them fail to reveal uniquely low distortion figures. (But admittedly, basic distortion measurements don't tell all.) Yet, owners of high-end gear frequently report immense satisfaction with the sound that comes from their systems. I personally know several audiophiles who state that their quest for a superb amplifier was reached when they purchased the Mark Levinson ML-2, a 45-watt class-A monophonic amplifier (two are necessary for stereo) costing \$2,500 per channel. There have been controlled subjective listening tests on such super components that suggest that the pleasure they give may come from nonsonic influences, for definitive evidence of superior sound has been elusive. On the

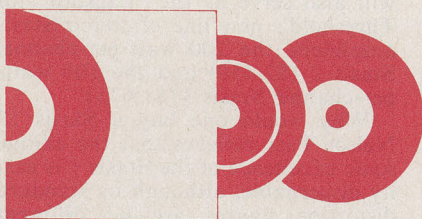
other hand, reviewers in small audiophile magazines find distinguishing aural characteristics to commend this special class of audio equipment.

Of course, subjective listening musical experiences and the pleasure derived can be modulated by an owner's perception of a unit's appearance, the reputation of the designer, and the expectation of what a cost-no-barrier approach can yield. Similarly, one may have different expectations climbing into a \$14,000 Corvette than into a \$125,000 Lamborghini for a test drive, even though both qualify as sports cars. These expectations produce powerful psychological effects. Pride of ownership and self-esteem can account for some of the listening pleasure an audiophile obtains from his system.

Those willing or able to pay the price may gravitate to unusual, exotic designs. For example, the helium-atmosphere Plasmatron speaker, which seems better suited to a physics

lab than the living room, stands as an innovative use of plasma technology to produce an outstanding transducer—at a cost of \$9,000.

One tangible benefit the audiophile who purchases high-end equipment is likely to receive is outstanding service from the dealer and manufacturer. Often, the customer can call the factory and speak directly with the designer. Further, updates of circuit design are often offered at a fraction of the original purchase price of the equipment, and repairs are easily obtainable. Moreover, some audio dealers who sell such equipment are willing to supply "loaner" electronics, so that your system can continue to operate while a component is being repaired. In summary, those able to own "price-no-object" equipment will own equipment with sound as good as anything available, elegant craftsmanship, and conservative engineering that contributes to greater longevity—and receive solicitous service as well. ♦



Audiophile Recordings

By Harold A. Rodgers
Executive Editor

SAINT-SAËNS: *Symphony No. 3, "Organ."* Eugene Ormandy conducting the Philadelphia Orchestra; Michael Murray, Organist. Telarc 10051. Well, it has happened at last! Telarc has made the jump into the major leagues. This recording is the young company's first of a major symphony orchestra, and it has been done in fine style. Recorded digitally, of course, the sound encompasses a stunning dynamic range while retaining the subtleties of lightly scored passages. Just occasionally a touch of groove noise obtrudes with a gentle reminder that we are listening to a recording after all, but that is because the immense dynamic range forces the minimum level closer to the noise than would ordinarily be the case. At the other end of the range, more than a few prestigious phono pickups will sound a mite breathless tracking the peak levels. Telarc is here pushing the vinyl, and right to the limits—or awfully close.

Ormandy, Murray, and the orchestra do an excellent job. The opulent sound characteristic of the Philadelphia is well in evidence and well under control. The attacks have just the amount of diffuseness to render the

sound warm rather than clinical, yet, at the same time, they are never permitted to lapse into vagueness or inaccuracy. One is tempted to conclude that St. Francis de Sales Church in Philadelphia is a particularly felicitous recording environment. This is a thrilling recording, and, as it should be one of Ormandy's final readings of the work, could easily become a collector's item.

TCHAIKOVSKY: *Symphony No. 6 in B Minor, Op. 74, "Pathétique."* Kurt Sanderling conducting the Berlin Symphony Orchestra. Denon OX-7183-ND. Sanderling's approach to this symphony seems to be to take everything right to the limit. He takes the opening about as far in the direction of romantic expressiveness (some would say schmaltz) as anyone I have ever heard, then makes a quick change in mood and renders Tchaikovsky's gimpy 5/4 "waltz" (*Allegro con grazia*) with as much *grazia* as anyone could want. Similarly, the third movement makes much of forcefulness, and the fourth returns to schmaltz.

The recording was made with Denon's PCM (digital) process, and has basically fine sound. The warmth of sound that characterizes many European recordings (in contrast to the more analytical sound preferred by many Americans) is abundantly present. However, whether through some quirk in miking or recording, or, more likely, in the acoustics of Christuskirche in East Berlin, bass frequencies are overrepresented. The entire texture at times becomes excessively turgid and heavy. The problem can be relieved to a large extent with a deft touch on the bass control of your amplifier, which is fortunate, for the performance is well worth hearing.

STEELEYE SPAN: *All Around My Hat.* Mobile Fidelity MFSL 1-027. Given the task of choosing a Steeleye Span album for remastering, I think I would have made a different choice—*Parcel of Rogues* and *Now We Are Six* coming to mind as candidates. But this one, although less spectacular than those, to my taste, does have a way of growing on one. There is not a great deal of showing off, but there is much musical expressiveness. And some of the arrangements approach genius.

For those unfamiliar with this now-disbanded group, its stock-in-trade consists of British folk song and dance melded with the modern rock medium in a unique way. It is a pity that Mobile Fidelity includes nothing in the way of program notes other than a description of its manufacturing process and the like. The unfamiliar dialects and odd vocabulary (at least for a modern American listener) cry out for the inclusion of written words of the songs and explanations where necessary. In any case, it would be nice to know more about the background of this delightful material and the group that produced it.

New Releases:

BOITO: *Prologue to Mefistofele*; VERDI: *Te Deum*. The Atlanta Symphony Orchestra and Chorus under Robert Shaw; John Cheek, Bass. Telarc DG-10045.

CHAUSSON: *Concerto Op. 21*. Israella Margalit, Piano; Lorin Maazel, Violin; The Cleveland Orchestra String Quartet. Telarc DG-10046.

FOR ELISE—AND OTHER BEAUTIFUL FLOWERS OF PIANO MUSIC. John O'Connor. Denon OX-7177-ND. ♦

THE REALIZATION OF GREAT EXPECTATIONS.

THE SANSUI "Z" SERIES.

Music lovers expect uncommon products from Sansui. And Sansui delivers. The new Sansui "Z" Series of synthesized digital receivers are designed and built with a loving logic that can be seen, touched and heard. Take the Sansui 5900Z, a reasonably priced receiver with every important feature you could possibly want for the heart of your high fidelity system.

SYNTHESIZED DIGITAL TUNING

You can't mistake a Sansui synthesized digital receiver. Not even a little. Press the up/down tuning buttons. The digital circuitry ensures that every station received is automatically locked in for lowest possible distortion, with its frequency indicated both on a digital readout and by an LED indicator along an analog type dial.

TOUCH VOLUME CONTROL & LED PEAK POWER LEVEL INDICATOR

The Sansui 5900Z uses a pair of touch-buttons to adjust the listening level. Relative volume control setting is indicated on a fluorescent display. Actual peak power amplifier output is shown by 14-segment LED indicators.

12 PRESET STATIONS

To make FM and AM tuning still easier, up

to 12 user-selected stations may be "stored" in the 5900Z's memory circuits for instant recall. The last station received will be remembered when the tuner is turned on again; and memories are kept "live" even during a power outage.

DC-SERVO AMP FOR DEPENDABLE POWER

The leader in DC technology, Sansui uses a servo-controlled amplifier circuit in all "Z" receivers to eliminate unwanted ultra-low frequencies — like record warps — while maintaining the advantages of direct-coupled circuitry in their amplifier sections. The 5900Z delivers 75 watts/channel, min. RMS, both channels into 8 ohms, from 20-20,000Hz, with no more than 0.03% THD.

And there's more. Like LED's for every important function. Two Muting Modes. AM stereo capability. And much more.

Visit your Sansui dealer and make sure you

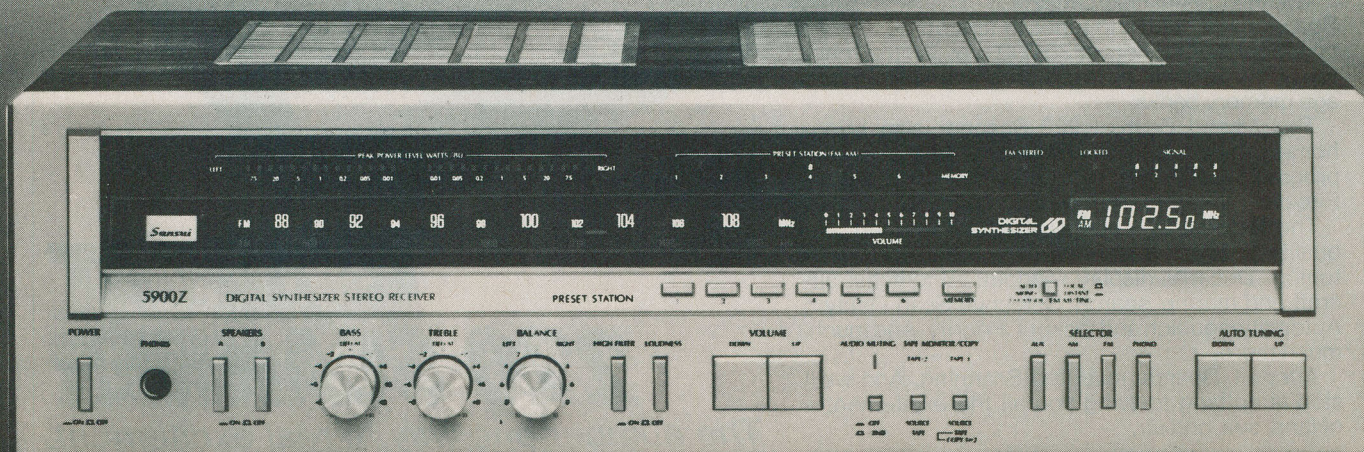
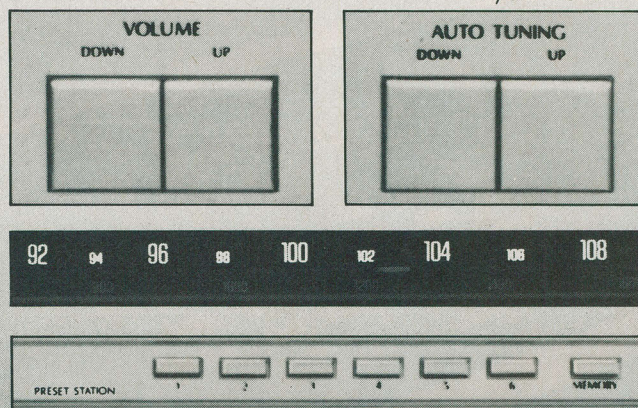
see all the wonderful stereo receivers in the Sansui "Z" Series. And expect great things. You won't be disappointed.

CIRCLE NO. 67 ON FREE INFORMATION CARD



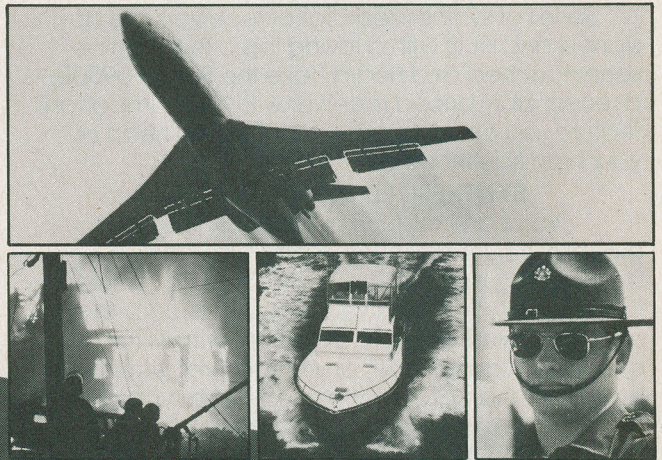
SANSUI ELECTRONICS CORP.

Lyndhurst, New Jersey 07071
Gardenia, Ca. 90247
SANSUI ELECTRIC CO., LTD., Tokyo, Japan
SANSUI AUDIO EUROPE S.A., Antwerp, Belgium
In Canada: Electronic Distributors



TUNE IN AMERICA'S LAND, SEA AND AIR SCANNER.

The incredible, no-crystal Bearcat 220 Scanner tunes in all the real excitement of AM aircraft communications plus FM public service frequencies, with pushbutton ease.



Now.

Tune in all the real excitement of the wild blue yonder, at the touch of a button.

The no-crystal Bearcat 220 Scanner searches and tunes in aircraft communications. Jets at 30,000 feet. All the tense tower talk. Everything is pre-programmed in space-age memory banks.

The 7-band Bearcat 220 Scanner also brings home public service frequencies, too. Pre-programmed Marine frequencies. Police action. Fire calls. Weather warnings. You name it.

The Bearcat 220 has all the features and quality Bearcat Scanners are famous for. Track tuning. Decimal display readout. Automatic aircraft and marine search. Selective Scan Delay. Automatic squelch and lockout. Priority. And much, much more.

After all, Bearcat invented Scanning. And we'll stop at nothing to bring you all the excitement—of land, sea, and air.

BEARCAT® 220 SCANNER

The number one way to real excitement.

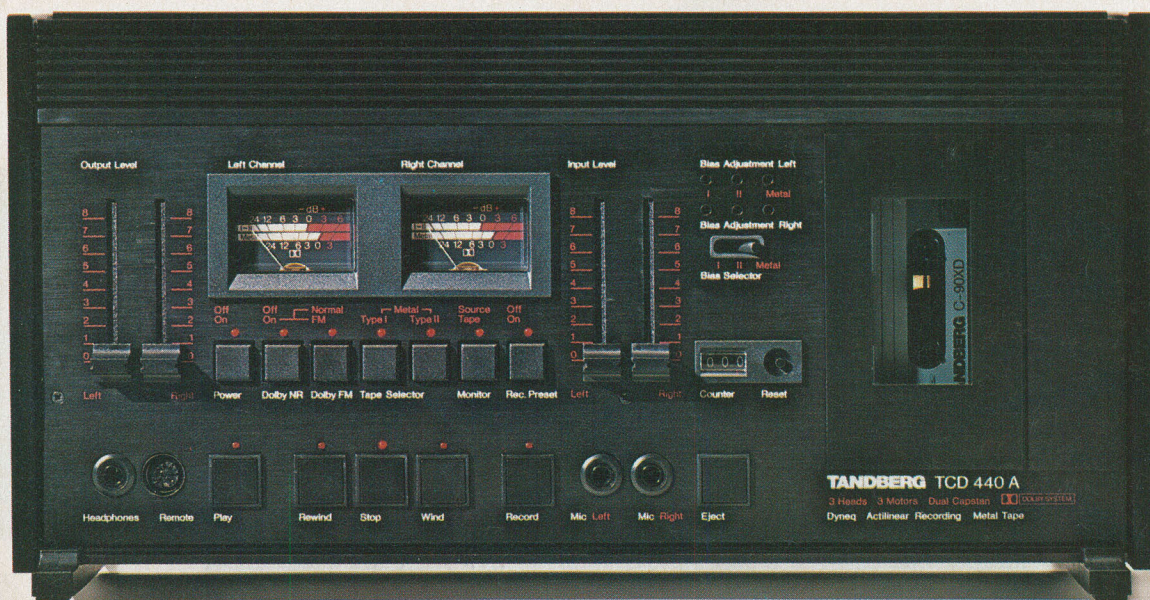
Electra

Copyright 1980 Electra Company • Division of Masco Corp. of Indiana • 300 East County Line Road, Cumberland, Indiana 46229

CIRCLE NO. 24 ON FREE INFORMATION CARD

Audio Product of the Month

CHOSEN BY THE EDITORS OF POPULAR ELECTRONICS



Tandberg Model TCD-440A Cassette Tape Deck

Three-motor, three-head machine has DYNEQ dynamic record EQ and ACTILINEAR recording amplifiers

HEADING the latest line of cassette decks from Tandberg is the TCD-440A, a deluxe three-motor, three-head machine. The TCD-440A incorporates Tandberg's DYNEQ dynamic equalization system for greatly reduced high-frequency tape overload, and the ACTILINEAR recording system that permits effective use of metal alloy tapes without saturation of the recording amplifiers.

The Tandberg TCD-440A can be installed in a vertical or a horizontal position, with removable supporting feet supplied for vertical mounting. The all-black finished recorder measures 18⁵/₁₆" W × 8⁷/₈" D × 4" H and weighs 14.5 pounds. The suggested selling price is \$1600. An optional infrared remote control unit is \$150.

General Description. The transport is controlled by light-touch but-

tons that operate solenoids. The usual pause feature is lacking, but RECORD can be activated by touching a single button if a separate REC. PRESET button has been previously engaged. Logic circuits make it possible to go directly from any speed or mode to any other. "Flying start" recordings can be made by pressing the RECORD and PLAY buttons while the tape is playing, and releasing PLAY before releasing RECORD.

Other pushbutton switches control POWER, DOLBY NR, and internal equalization time constants. A DOLBY FM button, when used in conjunction with the DOLBY NR button, converts the deemphasis time constant of a received FM broadcast from 75 to 25 microseconds before decoding and recording it. Separate pushbuttons set the machine for Type I and Type II tapes. These are IEC designations for

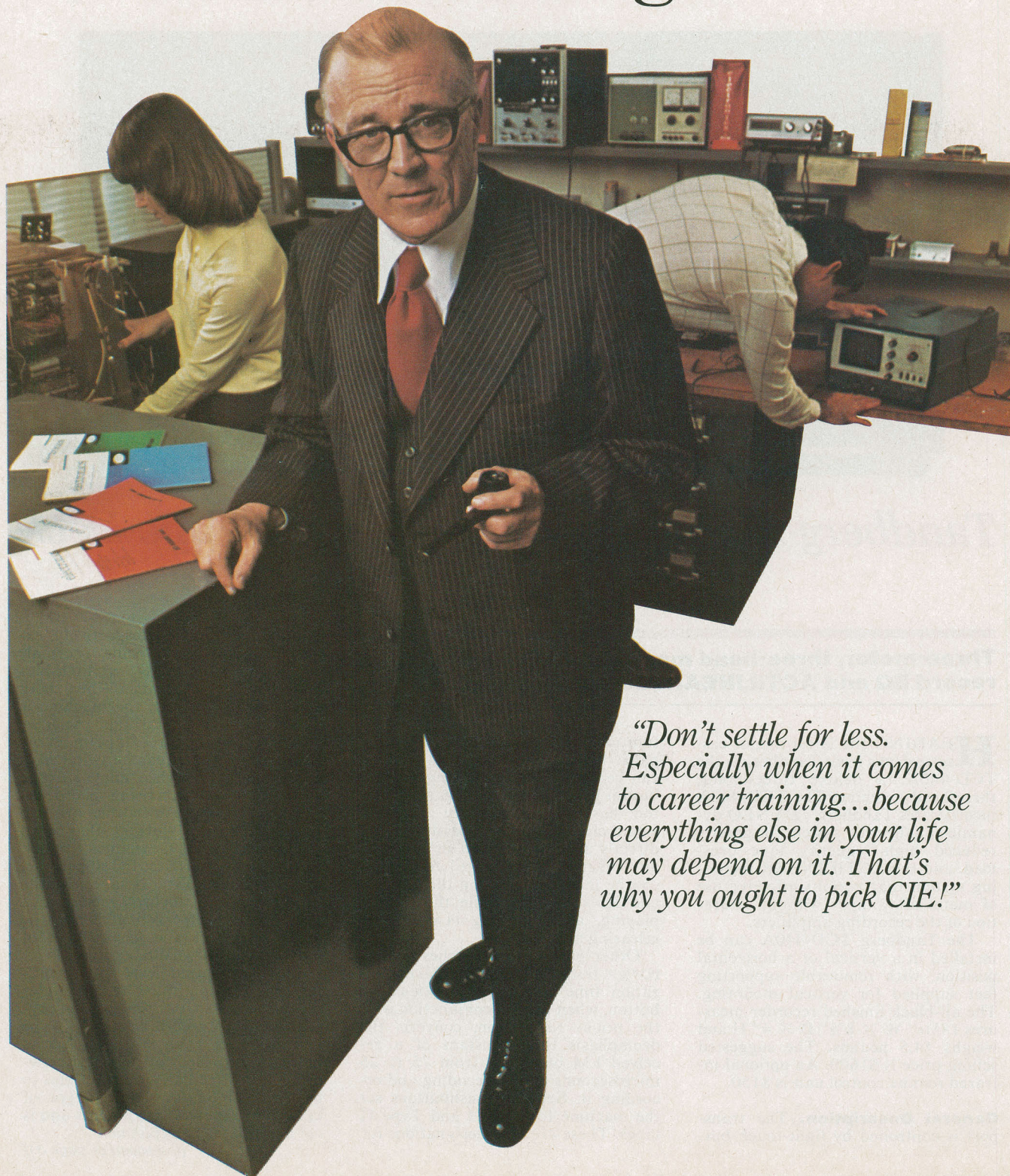
general tape classes, respectively, exemplified by ferric oxide (normal) tapes and either CrO₂ or high-bias ferricobalt equivalents. When both buttons are engaged, the machine is set for Type IV (metal) tape. Another button controls source/tape monitoring. An MPX filter can be switched in to attenuate 19-kHz pilot leakage from FM broadcasts being recorded.

Above the control buttons are two illuminated level meters that read peak levels of the equalized signal. They have two scales; the upper one, for Type I and Type II tapes, has its "0 dB" calibration corresponding to a tape flux of 250 nWb/m, while the lower, for metal tape, has its 0 dB set 4 dB higher (400 nWb/m).

Playback output level and recording level are controlled by dual slider potentiometers. A three-position toggle switch sets recording bias for Type I, Type II, or Type IV tapes. Access holes are provided for internal screwdriver adjustments that permit bias to be trimmed for any specific type of tape. This requires instruments and is not a normal user adjustment.

(Continued on page 31)

“If you’re going to learn electronics, you might as well learn it right!”



*“Don’t settle for less.
Especially when it comes
to career training...because
everything else in your life
may depend on it. That’s
why you ought to pick CIE!”*

You've probably seen advertisements from other electronics schools. Maybe you think they're all the same. They're not!

CIE is the largest independent home study school in the world that specializes exclusively in electronics.

...

Meet the Electronics Specialists.

When you pick an electronics school, you're getting ready to invest some time and money. And your whole future depends on the education you get in return.

That's why it makes so much sense to go with number one... with the specialists... with CIE!

There's no such thing as bargain education.

If you talked with some of our graduates, chances are you'd find a lot of them shopped around for their training. Not for the lowest priced but for the best. They pretty much knew what was available when they picked CIE as number one.

We don't promise you the moon. We do promise you a proven way to build valuable career skills. The CIE faculty and staff are dedicated to that. When you graduate, your diploma shows employers you know what you're about. Today, it's pretty hard to put a price on that.

Because we're specialists, we have to stay ahead.

At CIE, we've got a position of leadership to maintain. Here are some of the ways we hang onto it...

Our step-by-step learning includes "hands-on" training.

At CIE, we believe theory is important. And our famous Auto-Programmed® Lessons teach you the principles in logical steps.

But professionals need more than theory. That's why some of our courses train you to use tools of the trade like a 5 MHz triggered-sweep, solid-state oscilloscope you build yourself—and use to practice troubleshooting. Or a Digital Learning Laboratory to apply the digital theory essential to keep pace with electronics in the eighties.

Our specialists offer you personal attention.

Sometimes, you may even have a question about a specific lesson. Fine. Write it down and mail it in. Our experts will answer you promptly in writing. You may even get the specialized knowledge of all the CIE specialists. And the answer you get becomes a part of your permanent reference file. You may find this even better than having a classroom teacher.

Pick the pace that's right for you.

CIE understands people need to learn at their own pace. There's no pressure to keep up... no slow learners hold you back. If you're a beginner, you start with the basics. If you already know some electronics, you move ahead to your own level.

Enjoy the promptness of CIE's "same day" grading cycle.

When we receive your lesson before noon Monday through Saturday, we grade it and mail it back—the same day. You find out quickly how well you're doing!

CIE can prepare you for your FCC License.

For some electronics jobs, you must have your FCC License. For others, employers often consider it a mark in your favor. Either way, it's government-certified proof of your specific knowledge and skills!

More than half of CIE's courses prepare you to pass the government-administered exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their Licenses!

For professionals only.

CIE training is not for the hobbyist. It's for people who are willing to roll up their sleeves and go to work... to build a career. The work can be hard, sure. But the benefits are worth it.

Send for more details and a FREE school catalog.

Mail the card today. If it's gone, cut out and mail the coupon. You'll get a FREE school catalog plus complete information on independent home study. For your convenience, we'll try to have a CIE representative contact you to answer any questions you may have.

Mail the card or the coupon or write CIE (mentioning name and date of this magazine) at: 1776 East 17th Street, Cleveland, Ohio 44114.



CIE **Cleveland Institute of Electronics, Inc.**

1776 East 17th Street, Cleveland, Ohio 44114

Accredited Member National Home Study Council

☐ **YES...** I want the best of everything! Send me my FREE CIE school catalog—including details about troubleshooting courses—plus my FREE package of home study information.

PE-22

Print Name _____

Address _____

Apt. _____

City _____

State _____

Zip _____

Age _____

Phone (area code) _____

Check box for G.I. Bill information: ☐ Veteran

☐ Active Duty

MAIL TODAY!

The computer that grows as you grow.



As your computer skills grow, so does your Heath H8 System. New accessories and software are coming along all the time to make your system do more.

Special bus design gives you seven plug-in board positions so you can configure any combination of memory, I/O's and accessories. You can interchange boards. Add accessories. Build exactly the system you want.

A wide selection of software makes your life more fun and more efficient. Hundreds of programs for business, home and family are available from Heath User's Group. Also two BASIC languages, Microsoft™ and Fortran™. And more programs are being developed all the time.

If you haven't seen the latest Heathkit catalog, you haven't seen the latest in computer fun. There's a new Music Synthesizer Board, new Speech Lab, new Color

Graphics Board and new Color Monitor. And coming soon, a new three-drive disk system. For an exciting computer hobby, there's no more exciting computer than the Heath H8 – available fully assembled or in money-saving kit.

For complete details and prices on the H8 and the complete line of Heath printers, terminals and accessories, write today for the new, *free* Heathkit Catalog, or pick one up at your nearby Heathkit Electronics Center.

CIRCLE NO. 32 ON FREE INFORMATION CARD

Heath®

Send for
**FREE
CATALOG**

Write to Heath Company, Dept. 010-696, Benton Harbor, MI 49022

Visit your Heathkit Store

In the U.S. and Canada visit your nearby Heathkit Electronic Center* where Heathkit products are displayed, sold and serviced. See the white pages of your phone book for the location nearest you.

*Units of Veritechnology Electronics Corporation in the U.S.



CP-188



Complete support, so you're never left out in the cold.

(Continued from page 25)

Also on the panel of the TCD-440A are a headphone jack, a socket for the optional remote control accessory, and two microphone jacks, as well as the tape index counter. The cassette door is hinged vertically and opens from its right side. The EJECT button operates through a solenoid, so that normally the cassette door cannot be opened unless the recorder is powered. If access is required to the cassette with power off, there is a special mechanical ejection lever underneath the recorder.

Pressing on the upper edge of a narrow metal door causes it to swing open and reveal the recording-head azimuth adjustment knob, a TEST switch and instructions for aligning the head before making a recording. The separate record and playback heads are far enough apart for slight tape skewing within the cassette to alter the effective alignment of their gaps. The playback head is factory aligned, but before making a recording it is necessary to adjust recording head alignment for the particular cassette being used. An internal 10-kHz oscillator facilitates this test.

DYNEQ is Tandberg's answer to tape saturation at high frequencies. It monitors the incoming program level—particularly its high-frequency content—and uses the information to control the response of a 20-kHz resonant peaking circuit in the recording amplifier. As the high-frequency energy in the signal increases, the high-frequency boost in the record amplifier is progressively reduced. This minimizes the possibility of tape saturation. High-frequency recorded flux is thus maintained constant over a wide range of input signal levels, resulting in an effective increase of high-frequency response that amounts to about 10 dB at 15 kHz. DYNEQ operates only during recording and yields a tape that is fully compatible with other recorders. In addition, it provides a dramatic reduction of intermodulation distortion.

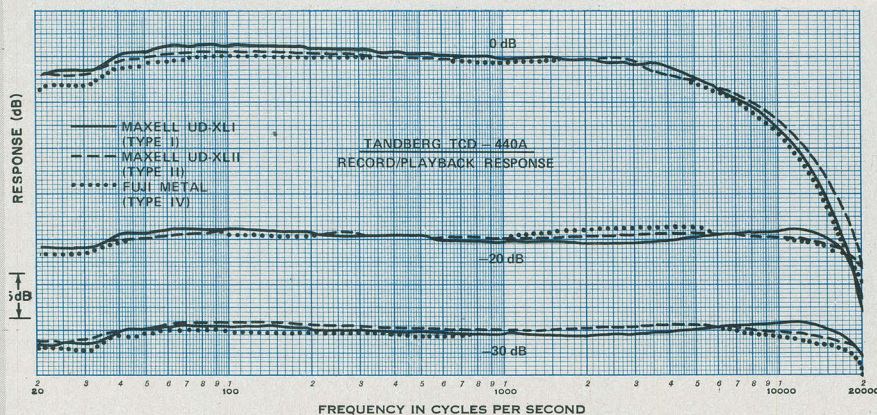
The ACTILINEAR system isolates the recording amplifier output from the bias signal injected into the recording head, reducing still further any intermodulation between the signal and the bias oscillator. In addition, it allows the recording amplifier some 15 dB of reserve headroom, even with the high signal levels recorded on metal tape.

Laboratory Measurements. Bias levels in the Tandberg TCD-440A have been factory adjusted for Maxell UD-XL I (Type I), Maxell UD-XL II (Type II), and Fuji Metal (Type IV) tapes, which we used in our tests. Playback equalization was first measured using TDK, Teac, and BASF test cassettes for both 120- and 70- μ s equalization. There were the expected minor differences between the different tapes, but the playback response was typically within 2 dB from 40 Hz to the upper limit on the tape (either 10 or 12.5 kHz).

Record/playback frequency response was measured with each of the basic tapes, using levels of 0, -20, and -30 dB on the recorder's meters. The response of the TCD-440A is specified at a -30-dB level relative to 250 nWb/m, although most other cassette recorders are rated at a -20- or -26-dB level. We found negligible difference between the -20- and -30-dB curves, and those were confined to the range above 15,000 Hz.

The TCD-440A is exceptionally free of the low-frequency "head bumps" that are present in the playback response of almost every cassette deck. Its response could be specified as ± 1.5 dB from 20 to 18,000 Hz with *any* of the tapes we used, at either a -20- or a -30-dB level. The 0-dB response curves began to roll off above 3 to 4 kHz, regardless of the tape. However, they did not fall to -20 dB until 18 to 20 kHz and never went below that. On most cassette decks, metal tape will give superior high-frequency response at high lev-

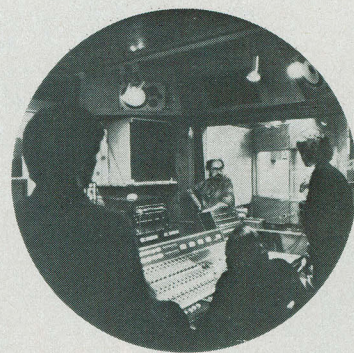
(Continued on page 34)



Frequency-response curves for three types of tape.

Study professional audio recording technology.

Learn to engineer the sound of music...



Complete the **Multi-track Recording Technology** curriculum in one year, or earn the **B.S. Degree in Music Technology** via the Institute of Audio Research—New York University joint program.

Fall '80 Quarter starts September 30th.

Write or call for brochure



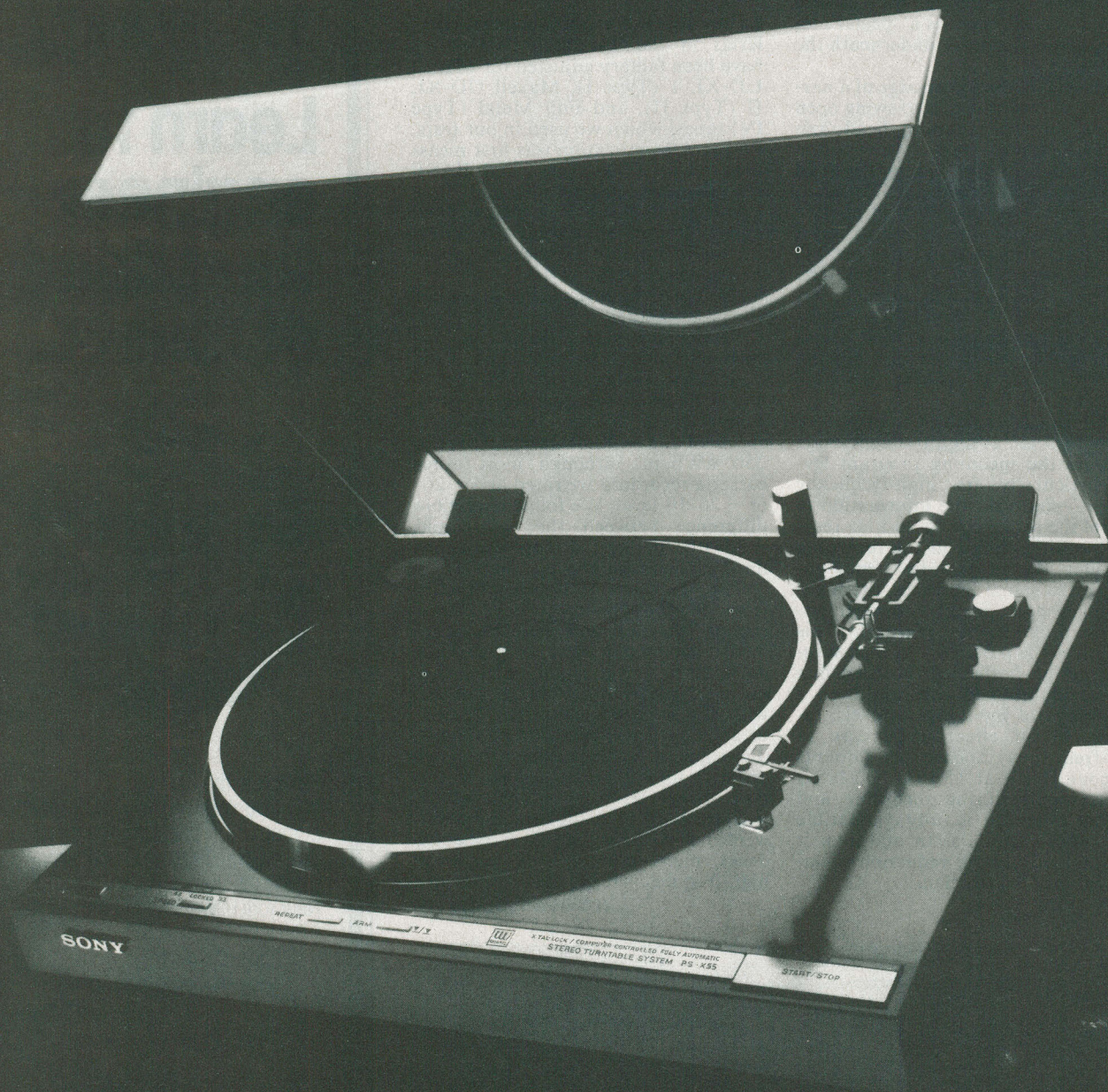
Institute of Audio Research

64 University Place
Greenwich Village
New York, N.Y. 10003
(212) 677-7580

Established 1969

Licensed by N.Y. State Dept. of Education

CIRCLE NO. 38 ON FREE INFORMATION CARD



SONY ELIMINATES THE MOST DISTURBING VARIABLES IN TURNTABLE PERFORMANCE, STARTING WITH THE WAY IT TURNS.

At Sony, our commitment to being #1 in hi-fi didn't stop with the reinvention of the receiver.

By applying "Total System Technology" we've eliminated the headaches that plague the turntable. And developed the first state-of-the-art turntable that won't put you in a state of bankruptcy. The PS-X55.

A DRIVE SYSTEM THAT'LL BE ACCURATE BEYOND THE YEAR 2000.

In order to insure your records turn at the prescribed speed, utterly smoothly and without fluctuation, Sony has improved its already advanced direct-drive system with an electronic speed-control circuit that works like a quartz watch.

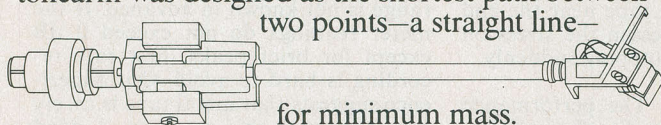
This gives the X55 up to 10 times more speed monitoring "pulse points" than competitive models, so it can better compensate for wow and flutter. We call this system "quartz-lock Magnedisc servo control." The audiophiles call it brilliant.

And unlike direct-drive motors found in competitive turntables, the X55's is both brushless and slotless. Which means it's even more accurate.

A NEW ANGLE ON THE TONEARM. STRAIGHT.

Sony engineers have paid meticulous attention to the X55's tonearm and its suspension.

Instead of the conventional shapes, the X55's tonearm was designed as the shortest path between two points—a straight line—



for minimum mass.

Minimizing mass maximizes compatibility with the widest range of cartridges, including the most advanced high-compliance types.

The tonearm pivot is supported in two places, not one. So it's virtually free of tonearm resonance, friction and side play.

And to let the platter motor do its job without interference, the X55 even has a separate motor that operates the tonearm during its automatic cycles. A technological advancement that's hard to

find on any turntable at any price.

THE STANDARD BY WHICH ALL BASES WILL BE JUDGED.

Instead of using an inexpensive plastic, wood or cast-aluminum base, like many of our competitors, the X55 is made of a Sony-patented inorganic "Bulk Molding Compound," which sharply reduces feedback.

And because loudspeakers produce vibrations that can be transmitted to the turntable through its feet, Sony created special gel-filled feet which absorb energy so effectively that the X55 will perform flawlessly even when your music is loud enough to rattle the walls.

Yet the X55's advancements don't stop here. A special muting device eliminates the "pop" that normally occurs when the stylus touches down or lifts up—something you'll particularly appreciate when transferring records to tape. There's even an electric eye that automatically measures the disc size.

But the bottom line is this. Once you compare the Sony X55 for specifications, features and price, you'll come to an inescapable conclusion. There's only one thing you need to know about high fidelity.

It's Sony.

SONY
High Fidelity

FEATURES AND SPECIFICATIONS: Fully automatic direct-drive turntable system/Linear BSL motor/Quartz-lock Magnedisc servo speed control/Electromagnetic braking/Sony Bulk Molding Compound anti-resonance base/Low-mass Duralumin tonearm/Logic IC function sequencing/Discrete tonearm servo motor/Speed accuracy $\pm 0.003\%$ /Wow and flutter (WRMS) 0.025%/Rumble (DIN B) -78 dB/Effective tonearm mass 8 grams.

© 1980 Sony Industries, a division of Sony Corp. of America, 9 West 57th Street, New York, N.Y. 10019. Sony is a registered trademark of the Sony Corporation.



Cleaning your records is only half the battle.

The best record cleaner in the world can't preserve a record. It can only clean it. A good record cleaner can remove dust, oily fingerprints and deep-seated dirt from the grooves. But, it can't protect the record from wear and friction.

The diamond is the hardest natural substance known. At the tip of a stylus, it is the spearhead of over 15 tons per square inch of destructive pressure that shears away microscopic chips of vinyl while traveling along the delicately thin grooves.

The finest high fidelity system can't restore the subtle high frequency and mid-range tones that are unavoidably lost.

Sound GuardTM Record Preservative is a scientifically designed, ultra-thin, dry formulation that practically eliminates record wear. Your records treated with Sound Guard Record Preservative will sound just as good after 100 plays. No hiss. No pops. No clicks.

Give your records 100% protection with two simple steps. First, clean them with Sound Guard Record Cleaner; then preserve them with Sound Guard Preservative. Buy them separately or get them both in the Sound Guard Total Record Care System. And stop record wear in its tracks.



Sound Guard Corp.
348 S.W. 13th Ave.
Pompano Beach
Fla. 33060

(Continued from page 31)

els, but the DYNEQ circuit seems to extract almost identical response from any kind of tape.

The Dolby circuits "tracked" well, resulting in a net response change of no more than 1 dB up to 10 kHz, or 2 dB between 10 and 15 kHz, between the Dolby "on" and "off" conditions, at recording levels of -20, -30, and -40 dB.

Depending on the tape used, a 0-dB meter reading required a recording input of 65 to 92 millivolts at 1 kHz. The corresponding maximum line playback levels were between 1.15 and 1.82 volts. At a 0-dB recording level, the playback third harmonic distortion was 0.8% with Type I, 0.5% with Type II, and 1.6% with Type IV tape (the latter being recorded to its 0-dB reference level, 4 dB higher than the others). The recording levels corresponding to 3% playback third-harmonic distortion were respectively +5.4 dB, +6 dB, and +2.5 dB for the three tapes.

Unweighted signal-to-noise ratios (S/N) referred to the 3% distortion signal level, were, respectively, 52.8 dB, 55.7 dB, and 56.1 dB for Type I, Type II, and Type IV tape. Using the Dolby system and CCIR/ARM weighting, these figures improved to 63.8, 67.5, and 67.3 dB. Through the microphone inputs, noise increased by 7 dB at maximum recording gain with a 1-k Ω input termination. (Gain of the microphone amplifier is a function of source impedance.) The crosstalk between channels at 1 kilohertz was -60 dB.

Standard test tapes confirmed that a flux level of 250 nWb/m produced a 0-dB meter reading in playback. Dolby calibration marks are at -2 dB (corresponding to a 200-nWb/m level), and Dolby test tapes gave meter readings of -1 and -1.5 dB on the two channels. The meters responded very rapidly to transients, reading 100% of steady-state values on 0.3-second tone bursts.

The tape transport ran 0.5% fast. Weighted rms (JIS) flutter was 0.07% and the weighted peak (CCIR) flutter was $\pm 0.1\%$. On a combined record/playback measurement, these readings increased to 0.1% and 0.15% respectively. In fast forward and rewind, a C-60 cassette was moved from end to end in the very fast times of 43 and 50 seconds, respectively. The transport slows the tape near the end of a fast wind to lessen the stress on the tape leader in stopping suddenly.

User Comment. The performance specifications of the Tandberg TCD-440A are listed in some detail in the product literature, and in every case where we were able to make a measurement, performance of the test sample met or surpassed its ratings.

In spite of—or perhaps because

of—its unconventional control and operating features, the TCD-440A is easy to use. Our only criticism of its design concerns the cassette door, which does not swing open far enough for easy loading or unloading of a cassette. In installations where access to the right side of the recorder is limited, the process becomes quite clumsy, since the cassette must be moved beyond the right edge of the recorder to clear the door when loading and unloading.

A standard subjective test we apply to cassette decks is to record interstation hiss from an FM tuner and compare the playback to the incoming signal. With many good recorders, the two sound almost exactly alike—except for minor midrange colorations. But this degree of accuracy can only be realized when the recording level is kept below -20 dB (-10 dB on a few of the better machines).

With very careful matching of the signal levels being compared, we heard no difference between the tuner hiss and the playback of the TCD-440A's recording, even at a 0-dB level! This is remarkable performance for a cassette recorder, especially since identical results were obtained with each of the basic tape formulations used.

The other aspect of the DYNEQ system—reduced intermodulation distortion and bias oscillator beats—is more difficult to verify because there is no way to compare the performance of the machine with DYNEQ to that of the same machine without DYNEQ. Fortunately, Tandberg has made a demonstration cassette in its laboratories, using a TCD-440A modified so that DYNEQ can be switched in or out, that leaves no doubt of the effectiveness of the system. It contains various test signals, recorded with the DYNEQ being switched on and off at a slow rate.

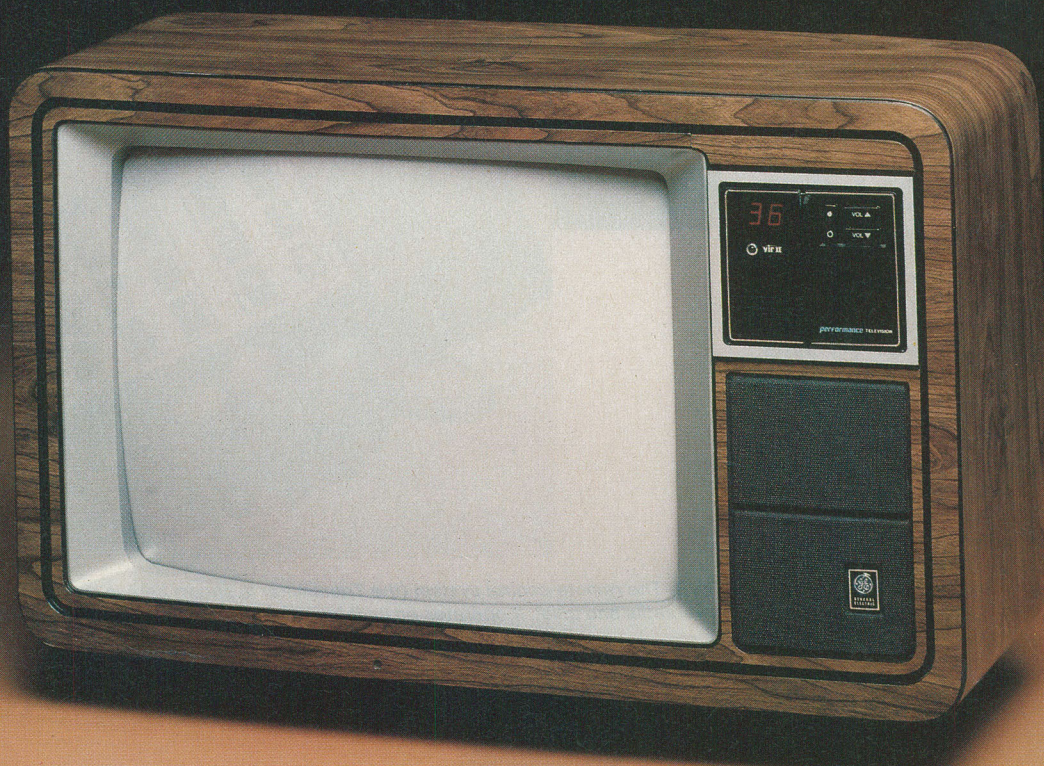
How much of this improvement will be apparent in recordings made on a TCD-440A depends largely on the program material. We are convinced that it is *capable* of making cleaner recordings of program material rich in high-frequency energy than most other cassette recorders. Even if that capability is not always in demand—or realized in practice—this recorder removes much of the worry from making recordings when the dynamic range is not known in advance. If the meter readings do not exceed 0 dB except for brief peaks, first rate recording is hard to avoid. Our experience suggests that metal tape is rarely necessary with this machine. A good Type II tape seems to extract virtually all the performance of which the machine is capable—and that is more than most people will ever need.—*Julian Hirsch.*

CIRCLE NO. 101 ON FREE INFORMATION CARD

Popular Electronics Tests

General Electric's 19"

Table-Top Color TV



GENERAL ELECTRIC has a few interesting design modifications in its upcoming 1980-1981 TV receivers. In truth, though, there are no design "breakthroughs" that significantly affect viewing and listening qualities. Changes that are made essentially enhance operating convenience, and, perhaps, reliability.

Accordingly, we felt free to examine a 19" table-top color model in the company's 1979-1980 line to give readers insight into what GE TV sets are like this year and next year in design and performance. (Besides, 1980-1981 receivers were not yet off the production line, let alone on dealers' shelves.) We'll note up-

coming minor changes that will occur in '80-'81 models as we go along.

The model examined here is 19EC0770W, which features VIR II color control, dual-mode remote control, room-light sensor, frequency-synthesized tuning that eliminates the need for a fine-tuning control, power consumption reduced by about 30% compared to GE's earlier chassis, black matrix in-line picture tube, and digital LED channel readout. Combine the foregoing with an attractive 27"W × 18"H × 18⁷/₈"D cabinet that's walnut finished on high-impact plastic, modular chassis for easy servicing, and a "tilt out" control bin, and you'll better understand why Gener-

al Electric is an important factor in the TV marketplace.

Remote Control. This receiver, which uses a series EC-A chassis, comes with a dual-mode, 82-channel remote control that is especially noteworthy, as pictured in Fig. 1. It is versatile (smooth up/down volume, up/down audio mute, keyboard channel selection or channel scan) and quiet (uses infrared beam). GE's upcoming E-line chassis, which is substantially the same as this one, has an even more advanced remote system. For one, it adds nine channels—all for midband cable TV—and its remote receiver section's memory can accommo-

date all 91 channels for scanning purposes, while the 1979-1980 model tested here handles up to 20 channels in memory. Otherwise, they're the same. Let's take a detailed look at how this sophisticated system works.

A block diagram of the remote transmitter, which is designated MP-82 for the receiver tested and MP-91 in 1980-1981 models, is shown in Fig. 2. They're powered by a nine-volt battery and emit a pulse-modulated beam of infrared.

Tuning commands are loaded in parallel form into 8-bit shift register IC30 by a 10-element keyboard and a diode matrix. These commands are either direct-address or scan. Depressing one or two digit keys (corresponding to the desired channel number) and then depressing the ENTER key loads a direct-address command into the register. Depressing either the CHANNEL UP or CHANNEL DOWN buttons constitutes a scan command and causes the appropriate 8-bit word to be loaded into shift register IC30.

An oscillator whose operating frequency is determined by a 566-kHz ceramic resonator generates a master clock signal for the transmitter that is processed by multistage counter IC10. First, the counter divides the input signal by 2048 to generate a 276.37-Hz pulse train. This signal is used to clock the 8-bit word serially out of the shift register. Counter IC10 also generates pulses having frequencies of 141.5 kHz ($\div 4$), 70.75 kHz ($\div 8$), and 35.38 kHz ($\div 16$). These signals are combined by an AND gate with the eight-bit data stream to form a composite pulse train with a nominal frequency of 35.3 kHz and a duty cycle of 12.5%. The pulse train modulates an array of three infrared LEDs that radiate a diffused beam of invisible light. It is this beam that's sensed and processed by the re-

(Continued on page 40)



Fig. 1. The remote-control system (the Transmitter is shown here in the inset) is versatile and quiet. It operates on an infrared beam and controls 82 channels.

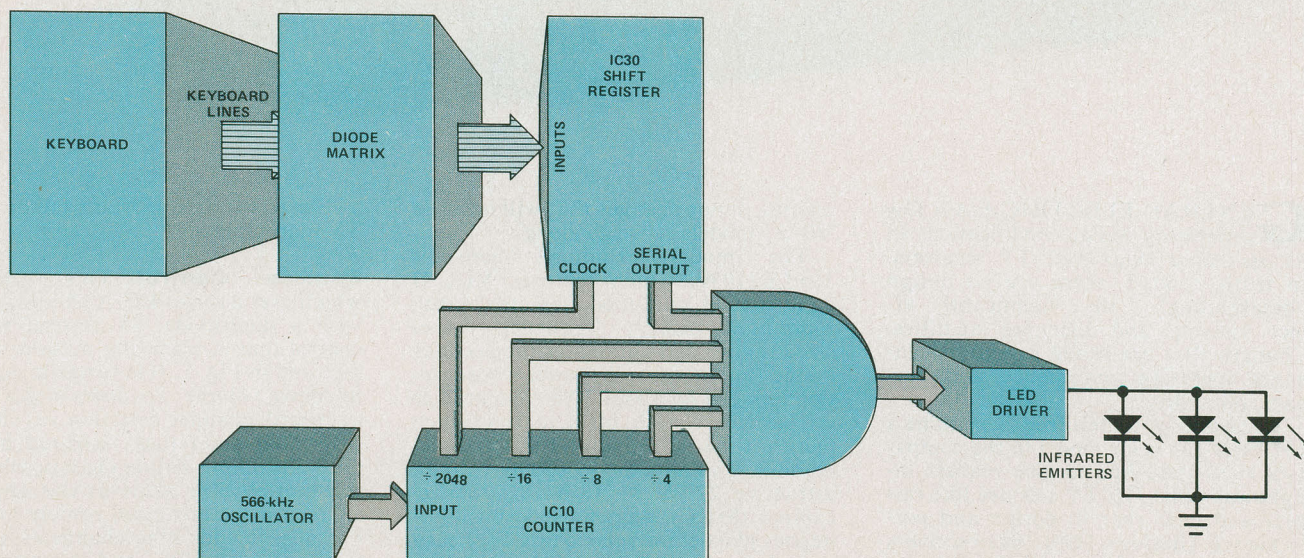


Fig. 2. Block diagram of the MP-82 remote transmitter. The MP-91 for 1980-81 models will be the same. The outputs of the shift register and counter are combined in the AND gate to form a composite pulse train.

This is no drill. This is the Air National Guard. The professionals who keep watch on the skies over America. All day. Every day.

It's serious business, because it's for real. And everyone from the jet engine mechanic to the weather technician knows it.

That's why they're here.

They know every time a pilot leaves the ground, they're riding with him. Their communications network, his ears. Their radar scopes, his eyes. Their aircraft maintenance, his life.

And whether it's a ground check on an

electronic circuit. Or a steady hand on a refueling boom nine miles high, everything they do brings a special satisfaction. Because it counts.

If you're looking for the chance to do something meaningful. If you've got what it takes to take on a real job. If you get that tingle down your spine when a jet engine fires up. Then maybe you

should help us do what we do. We Guard America's Skies.

See your local Air National Guard recruiter. Or call us toll-free

800-638-0936

(except in Alaska, Hawaii and Puerto Rico); in Maryland call 301-981-3610.

We Guard America's Skies.



The Guard belongs

When you're responsible for millions of miles of sky, you don't fly it alone.



CIRCLE NO. 52 ON FREE INFORMATION CARD

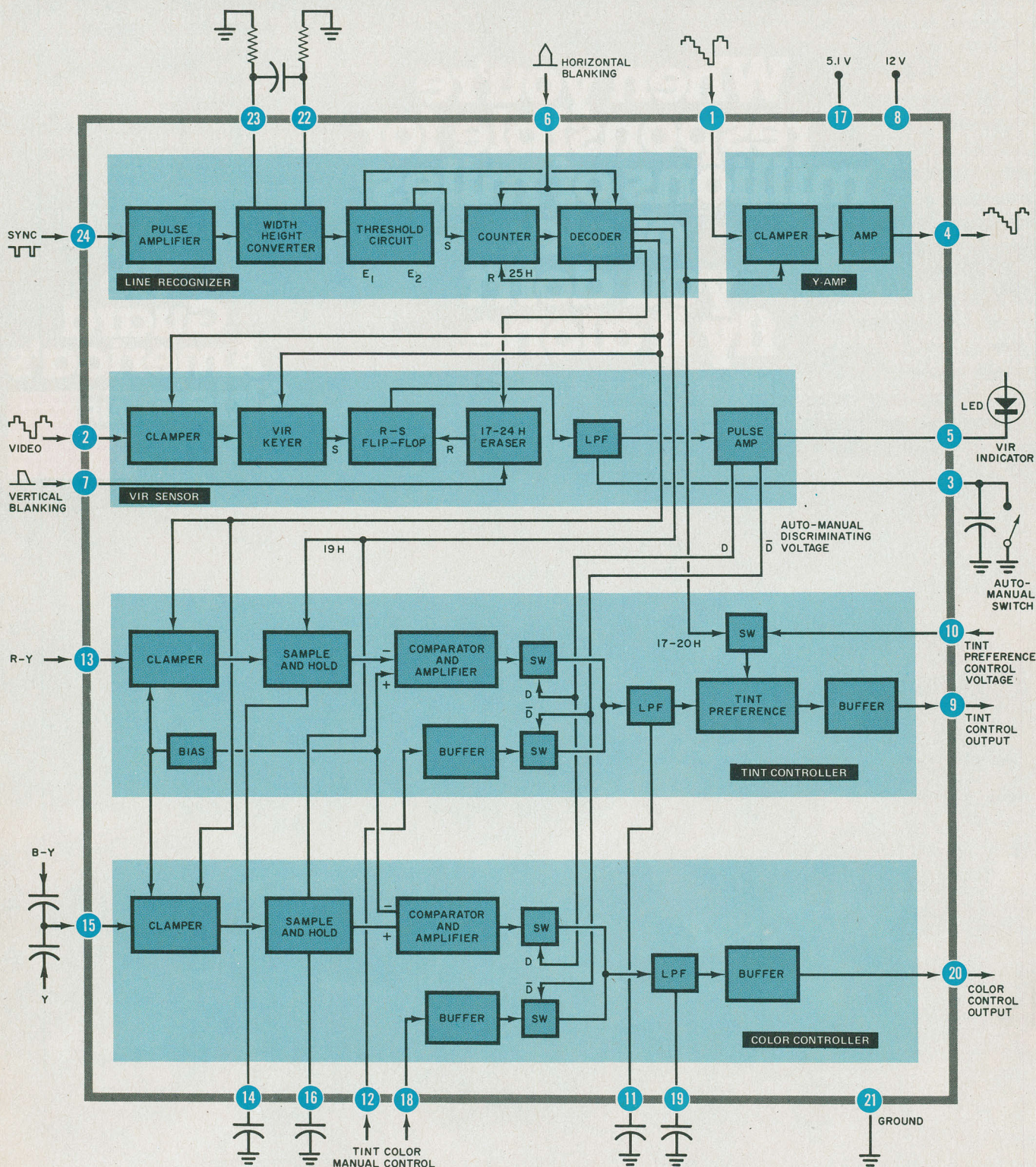


Fig. 3. Block diagram of the AN5330 IC used in the VIR II decoder. Control signals are derived from information transmitted on video line 19 (see Fig. 4).

mote-control receiver into commands for the tuner and several other stages in the TV receivers.

Infrared radiation from the remote transmitter passes through an optical filter (which screens out visible light) and excites a PIN diode. This component recovers the 35.3-kHz pulse train

and passes it through a tuned circuit to the first of several amplification stages.

A Schmitt trigger samples the output of the last amplifier stage and changes state when it senses reception of a pulse-modulated infrared carrier. When this happens, detected pulses are routed to the TUNER CONTROL module. This mod-

ule also accepts commands from the channel-select keyboard mounted on the television receiver. The module then passes commands to the tuner, phase-locked-loop synthesizer, master power on/off relay, audio control circuit and LED channel readout interface.

A microprocessor is at the heart of the

NOW! A MINIATURE TELEPHONICS SYSTEM
EVEN MA BELL DOESN'T MAKE AVAILABLE

FINGER FONE™

The unique Finger Fone brings you advanced solid-state wizardry with a simple yet intelligent approach to using a telephone. It's the ideal communications instrument for home and office.

Imagine you're a design engineer. You've just been assigned to come up with a smaller, simpler-to-use, more streamlined telephone with basic memory that can handle 99% of the ways people actually use a phone on a day-to-day basis.

You have a research laboratory with a support staff at your disposal. Plus access to the latest transistors, memory chips, and microprocessors. And you are given only one limitation: Keep the consumer's cost under \$100.

Now, since you're something of a maverick, your mind is not trapped in the right way/wrong way syndrome. And you were too independent to take that job with the Bell System while back. Because you didn't want all your ideas to come out "Bell-shaped."

THE ANATOMY OF DESIGN

So you set to work -- but not with wires, bells and whistles. Because your approach is different: You're going to discover how people actually use a telephone today and then design the instrument from the outside in, basing your conception around real communication needs in a way quite unlike anything ever before achieved.

INTRODUCING THE FINGER FONE

When you're finished, you realize you've come up with a minor revolution in design! Your new instrument is actually a miniature telephone: the entire unit measures a scant 2 3/4" wide, 8 3/4" long, and 2 3/4" high (at the speaker end), scarcely any bigger than the handset on an ordinary phone. Your Finger Fone has a nearly standard alphanumeric keyboard plus a couple of special benefits we'll get to in a minute. It also has an omnidirectional microphone, two microsensors on the side of the instrument to control the volume of incoming voices, and even a tiny red on-off light.

What's more, it plugs into the new mini-connector Ma Bell provides for all its phones these days -- with no additional wires for any other power source (which makes the Finger Fone unlike those other multi-wire "speaker-phones" that sell for more but do less).

WHY PICK A PHONE UP EVERY TIME IT RINGS?

Let's face it, your hands are often occupied when the phone rings. So to

answer, you've got to stop at least half of what you're doing. With a Finger Fone, all you do is reach out and tap the "On" key with one finger. And since you needn't pick the instrument up, you can place it conveniently on a desk, counter, or table -- or hang it on the wall.

MORE FINGERTIP CONVENIENCE

When Finger Fone announces an incoming call with its pleasant electronic chirp, tap the "On" key and begin speaking. If the caller is someone the whole family wants to hear, simply pass a finger over the high volume sensor, and your caller's voice will be audible to everyone in the room. This benefit is great for the office as well, making it possible to replace an ordinary telephone, separate speakerphone, and their complicated controls.

If you wish to speak with complete privacy, pass a finger over the low volume sensor. Yes, for strictly private calls you'll have to hold Finger Fone up to your ear. You won't mind, however, because the entire unit is a mere 11 1/4 ounces, just a featherweight more than ordinary telephone handsets.

YOU HEAR THEM, THEY DON'T HEAR YOU

Need to put your caller on "hold" for a moment? Easy. Tap keys 1 and 2 simultaneously, and the red light will dim. The other person won't be able to hear you, but you'll be able to hear him or her. We recommend you tell people about this so they don't make unguarded comments they think you can't hear. When you're ready to resume your call, simply tap keys 1 and 2, the red light will brighten and you can continue.

BUSY SIGNAL? FORGET IT!

Because Finger Fone automatically remembers the most recently dialed "busy" number. When you want to call that number again, tap the "RE" (Recall) key once. Finger Fone dials the number for you, as often as needed until you get a clear line.

WHY WAIT FOR PUSH BUTTON DIALING?

Finger Fone is compatible in areas of the country where push-button dialing is already in use. But if you live in the 30% or so of the country where only rotary-dial phones can be used, wait no longer. Finger



Finger Fone: Modular, sophisticated, smarter than your present telephone. Comes with an ivory fascia. For the base, you choose white, beige, tan, or blue.

Fone automatically converts from musical tones to rotary-dial signals. This way, you can have the speed and advantages of push-button dialing without waiting for your local phone company to install central equipment.

NOW AVAILABLE AT INCREDIBLE LOW COST

Finger Fone costs only **\$79.95** compared with prices of similar-looking telephones (but not similar in performance) costing \$109, \$130, or more. Want two? Then it's only **\$74.95** each. Three? Save even more at **\$69.95** each. Add a \$2.50 charge to your total order for insured shipping, and if you live in New Jersey, include 5% tax.

MONEY-BACK GUARANTEE

You can try one or more Finger Fones in your own home for 30 days, protected by our unconditional money-back guarantee. If you're not satisfied with Finger Fone for any reason, simply return it (insured) for a full refund, no questions asked. Finger Fone is also covered by a 1-year parts and labor guarantee.

Call TOLL FREE

800-257-7850

In New Jersey, Call: 800-322-8650

To order Finger Fone, call toll-free now. We're open 24 hours a day. You can charge it on Master Charge, Visa, American Express, Carte Blanche or Diners.

N.J. residents, add 5% sales tax. Or mail your order to:

Dept. PE8 Lakewood Plaza
Lakewood, N.J. 08701



NATIONAL SALES GROUP

Dept. PE-9, Lakewood Plaza
Lakewood, New Jersey 08701

International Sales
Dept. GQ8, Lakewood Plaza
Lakewood, New Jersey 08701

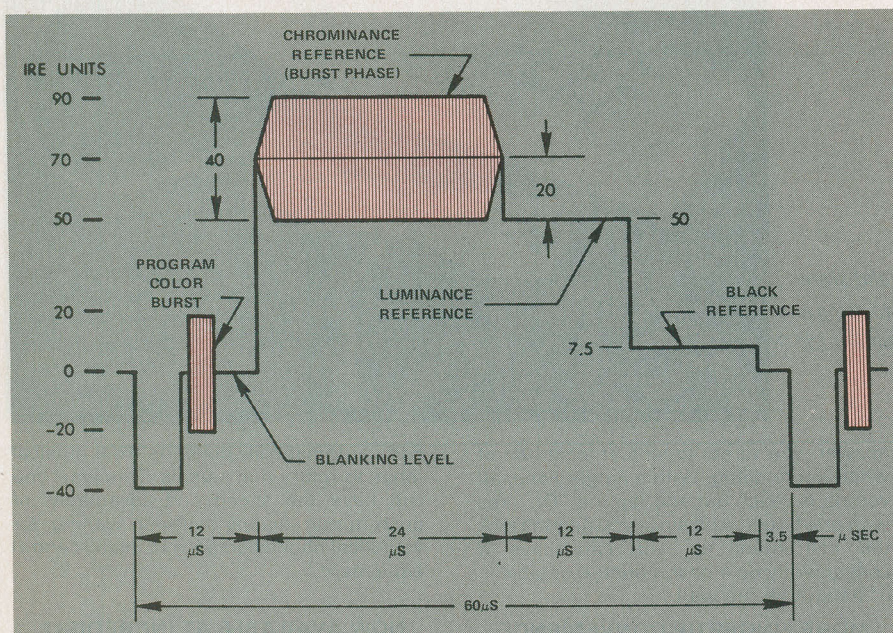


Fig. 4. Video line 19 is part of the 1.4-ms vertical blanking interval. It contains, among other things chrominance, luminance and black-reference information.

TUNER CONTROL module. The processor chip contains 2048 8-bit bytes of ROM, 128 4-bit nibbles of RAM, and various registers, output latches and buffers. Latching pulses permit retention of channel numbers for subsequent processing and delivery to the READOUT INTERFACE. The interface drives a pair of large seven-segment LED readouts that display the selected channel number.

Phase-Locked Loop. Working in tandem with and under control of the microprocessor-based TUNER CONTROL module is the PLL module. This is one of the key elements in GE's frequency-synthesized tuning system, eliminating the need for a fine-tuning control.

The bulk of this module's functions are performed by two ICs—a PRESCALER chip and a PLL TUNER CONTROL IC. Stages in the PRESCALER IC include vhf/uhf tuner control logic, several amplifiers, and a $\div 256$ counter. The PLL TUNER CONTROL chip in the 1979-1980 PLL module contains a 4-MHz oscillator (whose frequency is controlled by an external quartz crystal), a $\div 2048$ counter, a 15-bit latch and shift register, a programmable divider, a phase comparator, and various control logic. Similar stages are used in the 1980-1981 module's chip, though the counter has a modulus of 1024. This counter generates a low-frequency (either 3906-Hz or 1953-Hz, depending on the modulus of the counter) reference signal for the phase-locked loop's phase comparator.

When the viewer makes a channel selection, a string of 16 bits is presented to the serial DATA input of the PLL TUNER CONTROL chip by the TUNER CONTROL module. Of these 16 bits, 13 are applied to the modulus-select inputs of the chip's

internal programmable divider. Another bit is used as a vhf high-band/low-band switching command, another as a vhf/uhf select signal, and the remaining bit is a start bit. The modulus of the programmable divider assumes the value appropriate for the channel selected, and the divider scales down the frequency of the tuner's voltage-controlled oscillator (which has been preconditioned by the PRESCALER chip). The frequency-divided vco output signal is applied to one input of the phase comparator, and the frequency-divided reference oscillator output is applied to the comparator's second input.

If the two signals applied to inputs of the phase comparator are not exactly equal in phase and frequency, a series of

“... combines good color picture performance with a host of convenience extras.”

pulses appears at the output of the phase comparator. A discrete low-pass active filter smooths these pulses into a dc level. Another discrete active filter removes any residual ripple at the clock frequency (1953 or 3906 Hz). The resulting dc error voltage is supplied to the tuner's voltage-controlled local oscillator. This closed-loop system obviates the need for an afc circuit and a fine-tuning control.

VIR decoding capability, pioneered by GE in 1977, is a significant feature of General Electric's large-screen color receivers. Not every television station transmits a VIR-encoded signal, of course. However, when stations do, the same tint and chroma levels are automatically reproduced by the receiver CRT in a viewer's home. (This system also has the potential for automatic controls of overall brightness and video levels.) A second-generation VIR system, known as VIR II, employs a decoder produced in IC form by the Matsushita Electric Company. It is this decoding circuit that is employed in the GE receiver we tested.

A block diagram of this IC decoder appears in Fig. 3. The decoder derives its control signals from information transmitted on video line 19, which is part of the 1.4-ms vertical blanking interval. As can be seen in Fig. 4, this line contains chrominance, luminance, and black-reference information, as well as a burst of 3.579545-MHz color subcarrier and an 11.1- μ s horizontal line-blanking interval with a 4.76- μ s horizontal sync pulse.

The VIR II decoder functions in the following manner. The LINE RECOGNIZER section accepts the composite sync presented to the IC and the horizontal-blanking pulses applied to pin 6. The VIR SENSOR section accepts the composite video signal at pin 2 and the vertical-blanking pulses appearing at pin 7. Blue-minus-luminance ($B-Y$) and luminance (Y) signals are summed by two capacitors and are applied to the COLOR CONTROLLER section via pin 15, while the red-minus-luminance ($R-Y$) signal is applied to the TINT CONTROL section via pin 13.

Composite sync pulses applied to the LINE RECOGNIZER section are amplified and processed by a width-to-height (duration-to-amplitude) converter. When the output of this converter exceeds a predetermined level, an enabling command (actually, a vertical sync pulse generated by the threshold circuit) is applied to one of the control inputs of the counter. The counter tallies the number of horizontal-blanking pulses applied to it. When it has reached a count corresponding to video line 19, the counter is reset by the decoder. The decoder is driven by the output of the counter, the horizontal-blanking pulses, and a second output of the threshold circuit, a pulse of 20- μ s duration that appears at the end of each horizontal-blanking pulse. Four decoder output lines keep track of the progression through the vertical-blanking interval: the line-19 output; the lines-17-through-20 output; the lines-17-through-24 output; and a line-25 reset output. The logic levels appearing on these output lines govern operation of key elements in the rest of the VIR II decoder chip.

The VIR SENSOR section receives external video and vertical-blanking inputs as well as two outputs developed by the

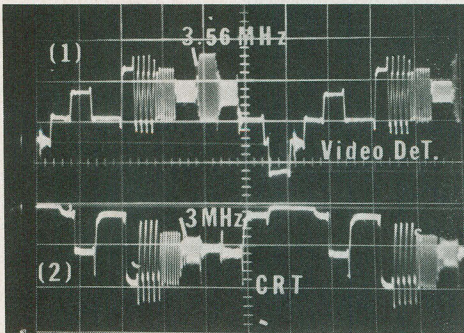


Fig. 5. Waveform photo of video detector and CRT responses from 75 to 4.08 MHz multiburst.

on-chip decoder just described. Composite video is clamped to the black level and is applied to the signal input of the VIR KEYER. When the luminance-reference component of line 19 exceeds a certain level, the VIR KEYER sets the RS flip-flop. This causes the VIR INDICATOR LED to glow, alerting the viewer that a VIR-encoded signal is being received (it's also defeatable by the viewer). The vertical-blanking pulse at pin 7 causes the 17-24 H eraser circuit to reset the flip-flop before line 17 and after line 24.

The combined *B-Y* and *Y* signal is applied to the COLOR CONTROLLER's input section and is level-shifted by a biased clamper. The clamper's output is sampled during the interval that the line-19 output of the LINE RECOGNIZER decoder is activated. A sample-and-hold circuit stores the instantaneous signal level and presents it to a biased comparator/amplifier stage. Any voltage difference between the bias and signal levels is amplified and passed by a transmission gate to a low-pass filter, which generates a color-control voltage. This voltage is buffered and routed to pin 20

of the IC. It is then used to control the amplitude of the *B-Y* signal so that the chroma level (color) reproduced by the receiver CRT matches that in the broadcast studio.

Operation of the TINT CONTROLLER section is similar to that of the COLOR CONTROLLER. A biased clamper level-shifts the *R-Y* signal applied to pin 13, and a sample-and-hold circuit evaluates and stores the clamped signal level. The signal is then compared to a fixed bias level and any difference is amplified and routed through a transmission gate to a low-pass filter. The filter's output is gated with a manually determined TINT PREFERENCE CONTROL VOLTAGE. A buffer passes the selected gate input signal to pin 9, where it is designated the TINT CONTROL OUTPUT. When the chrominance and black-reference levels are equal in amplitude at the receiver's *R-Y* output, the chroma phase (tint) conforms to that of the transmitted reference signal. Any amplitude discrepancy results in generation of a voltage that's applied to the control input of the receiver's 3.579545-MHz oscillator. This causes tint correction.

Color Monitor. When VIR-encoded signals are *not* being received, General Electric's "Color Monitor" circuit controls color and tint of the reproduced image. Like other automatic color-control circuits, the Color Monitor shifts yellows, oranges, reds and magentas to an "ideal" flesh-tone area about 50° into the second quadrant of a vector diagram with 0° or 360° burst. Also, it enlarges the angle of demodulation from the normal quadrature to approximately 105°. However, in contrast to a number of other designs, General Electric's Color Monitor circuit is dynamic, not static, in its operation. So let's examine this module's circuit.

The COLOR MONITOR module accepts inputs from the brightness limiter, the

three chroma-demodulator output lines (*R-Y*, *B-Y*, and *G-Y*), and an automatic/manual selector switch. During the horizontal-blanking interval, the ZERO CHROMA REFERENCE BIAS stage samples the *B-Y* output of the chroma demodulator and generates a dc voltage corresponding to a zero-color level. The CHROMA AVERAGING BRIGHTNESS TRACKING stage then samples *R-Y* and *B-Y* outputs of the chroma demodulator and compares them with the output of the ZERO CHROMA REFERENCE BIAS stage. The CHROMA AVERAGING BRIGHTNESS TRACKING stage also generates a control voltage that is applied to the CHROMA GAIN CONTROL stage.

Tint correction is achieved in the following manner: The *R-Y* BOOST and two MATRIX stages sample the three outputs of the CHROMA DEMODULATOR stage. These stages then generate control signals for the current sinks. The sinks limit amplitudes of the *R-Y*, *B-Y*, and *G-Y* chroma-demodulator outputs. An *R-Y* red boost compensates the *R-Y* and *G-Y* outputs to prevent any tendency toward color desaturation, especially in the yellows. And a current sink on the *B-Y* line subtracts any excess magenta component from the flesh tone that is produced by the receiver CRT.

Comments. There are a number of features incorporated into this GE color receiver that are noteworthy, but that have not been detailed thus far. Among them are a very-fast-warmup picture tube, high-voltage shutdown, electronic vertical/horizontal centering, and stiffly regulated power supplies. Of the highlights that we did examine carefully, VIR II and the infrared-remote and manual PLL-synthesized tuning system are true standouts.

Our experience with the receiver's remote control was that it is a delight to use. It offered the fastest up/down sequential scan that we have ever seen! Happily, picture and sound were exactly synchronized and always appeared at their preselected levels as quickly as we could enter the tuning commands by pressing the appropriate pushbutton.

Although the audio output is actually delivered at one of 63 discrete levels, the flow of audio up or down was very smooth to the ear. When volume was set at a certain level, the receiver turned off, and then turned on again, the volume returned to the preselected level. If line power failed and then returned, the audio output was at a median level the next time the receiver was turned on.

The fast-acting VIR II (or the Color Monitor, which backs up VIR II when VIR-encoded signal is being received) performed its task of automatically adjusting color and luminance extremely well. This made using the remote control even more convenient and enjoyable. Finally, we were pleased to note that commands to wireless garage-door openers, the jingling of keys, and stray signals from other sources did not disturb the

MODEL 19EC0770W RECEIVER LABORATORY DATA

Parameter	Measurement
Tuner/receiver sensitivity (before onset of snow):	vhf: -60 dBm uhf: -54 dBm
Voltage regulation (line varied from 105 to 130 V, r-f signal applied to input):	Low voltage: 120V supply (99%) 15V supply (99%) High voltage: 27 kV (98%)
Luminance bandpass at CRT:	3 MHz
S/N at CRT:	40 dB
Chassis power requirements (signal applied):	100 W
Horizontal overscan:	18%
Direct coupling (or dc restoration):	Approximately 90%
Convergence:	Greater than 95%
Audio bandpass (-3-dB points):	120 Hz to 8.8 kHz

infrared remote-control link in the least.

Rumor has it that General Electric might offer an optional add-on luminance/chroma comb filter later this year. This would result in a considerable increase in the video passband present at the control electrodes of the receiver's CRT, thereby improving resolution further. As can be seen in the oscilloscope photo of Fig. 5, the video passband at the output of the video detector (upper trace) exceeds that at the CRT (lower trace) by almost a full megahertz. Because this and other similar General Electric receivers have no color-killer circuit, the large 3.56-MHz component at the fourth multiburst in the upper

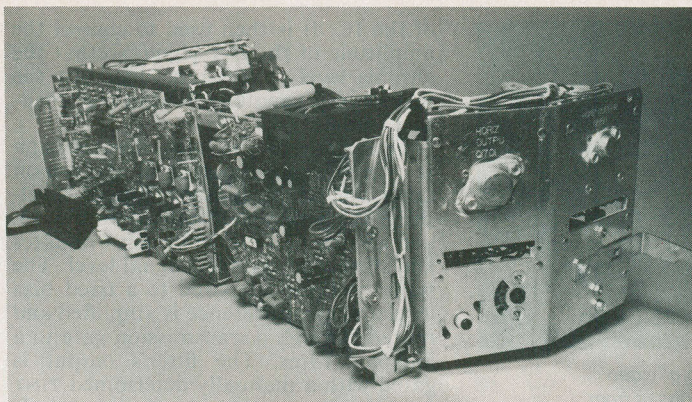


Fig. 6. Modular boards are mounted on both sides of an aluminum chassis. Boards are easily removed for service.

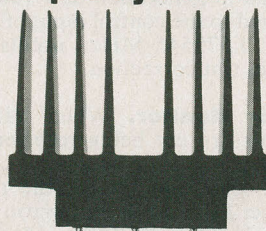


Audio Modules

Finally . . . quality, low cost modules
super-clean for hifi . . . reliable for pro systems!
with FULL FIVE YEAR WARRANTY!



- Built-in heatsinks
- Full circuit protection
- Totally encapsulated for thermal stability
- 5 simple connections

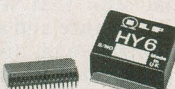


HY50 30 watts RMS \$28.95

True high fidelity from a compact module (4 x 2 x 1")! Use HY50 to build or upgrade a hifi system, run a small PA, amplify an instrument, or in a biamp/triamp system. Rugged aluminum heatsinks, with encapsulated circuitry. Mounts with two screws (provided). Low distortion 0.02% at 30 watts (1 KHz). Supply voltage $\pm 25V$.

HY30 15 watts RMS \$25.95

Superb compact amp, same size as HY50, but 15 watts RMS. Ideal for great variety of audio applications. Like all ILP modules, requires only 5 connections: input, output, positive and negative voltage, ground. And like all ILP modules, HY30 carries a five-year warranty! Distortion only 0.02% at 15 watts (1 KHz). Supply voltage $\pm 20V$.



HY6 Mono Preamp \$25.95 HY66 Stereo Preamp \$48.95

Contain complete circuitry for tone controls, accurate RIAA equalization, inputs for tuner, auxiliary, phono or mike, plus full tape monitor facility! Frequency response of DC to 100 KHz (+0, -3 db), distortion less than 0.005% signal/noise better than 90 db, output to 4.5 VRMS. Both types provided with plug-in edge connector (no soldering to module required!) Require 15V @ 10 mA. Extremely compact: HY6 (1 1/4 x 1 3/4 x 3/4"), HY66 (3 1/2 x 1 3/4 x 3/4"). Require controls 100K linear (volume), 10K linear (bass, treble) 10K linear (stereo balance). Optional pcb's are available for mounting of edge connector.
B6 for HY6 \$3.75 B66 for HY66 \$4.75

HY120 60 watts RMS \$59.95

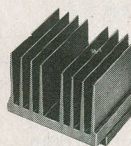
High performance amplifier, ideal for high fidelity applications. Features fully protected circuitry against shorts on input and output. Built-in fins very effectively dissipate heat. Distortion is ultra-low 0.01% at 60 watts (1 KHz). Compact size (4 1/2 x 4 x 2" D), easy mounting (two screws supplied), make HY120 a super buy! Supply voltage $\pm 35V$.

HY200 120 watts RMS \$79.95

Ideal amplifier for critical high fidelity applications. Widely complimented in Europe on its sound quality. High reliability open/short circuit protection-backed by 5 year guarantee. Distortion only 0.01% at full output (1 KHz). 5 simple connections. Also great for instrument amplification, PA, etc. $\pm 35V$.

HY400 240 watts RMS (4 ohm) \$99.95

ILP's most powerful amp designed for demanding situations, such as multi-speaker setups where reliability and high performance are essential. At high continuous levels, a cooling fan should be used. Features open/short circuit protection. Excellent sound quality. Distortion 0.01% at 240 watts (1 KHz). Size: 4 x 4 1/2 x 4". $\pm 45V$.



SPECIFICATIONS (Amp modules)

Load impedance — 4-16 ohms
Frequency response — 10 Hz — 45 KHz — 3 db
Input sensitivity/impedance — 500 mV/100 kohm
Signal/noise ratio — 100 db.

Dealer Enquiries Invited.

GLADSTONE ELECTRONICS

901 Fuhrmann Blvd., Buffalo, N.Y. 14203 since 1965

Name _____

Address _____

City _____ State _____ Zip _____

VISA _____ M/C _____ Card no. _____

IN CANADA: Gladstone Electronics, 1736 Avenue Rd., Toronto, Ont. (416) 787-1448. TOTAL

Phone orders (716) 849-0735

Please send
HY30 @ 25.95
HY50 @ 28.95
HY120 @ 59.95
HY200 @ 79.95
HY400 @ 99.95
HY6 @ 25.95
B6 @ 3.75
HY66 @ 48.95
B66 @ 4.75

CIRCLE NO. 28 ON FREE INFORMATION CARD

trace would produce even better resolution were it permitted to proceed (after some reduction in amplitude) directly to the CRT without an inordinate amount of trapping.

From a practical view, the method of chassis construction employed in this receiver might present some servicing problems. Modular boards are mounted on both sides of an aluminum chassis that offers no quick access to board bottoms. (See Fig. 6.) Boards are easily removable, though.

In all, the present GE TV receivers combine good color picture performance with a host of convenience extras. One rarely has to fiddle with the tint and color controls, for example, since it's all done automatically. The quartz-controlled channel tuning is precise, so there is no fine tuning required. And excellent chairside control is naturally a delightful feature for viewers who often switch from channel to channel. Also, the automatic room-light sensor maintains the right color intensity, contrast and brightness the user prefers in different ambient lighting conditions. Its level is manually adjustable, too.

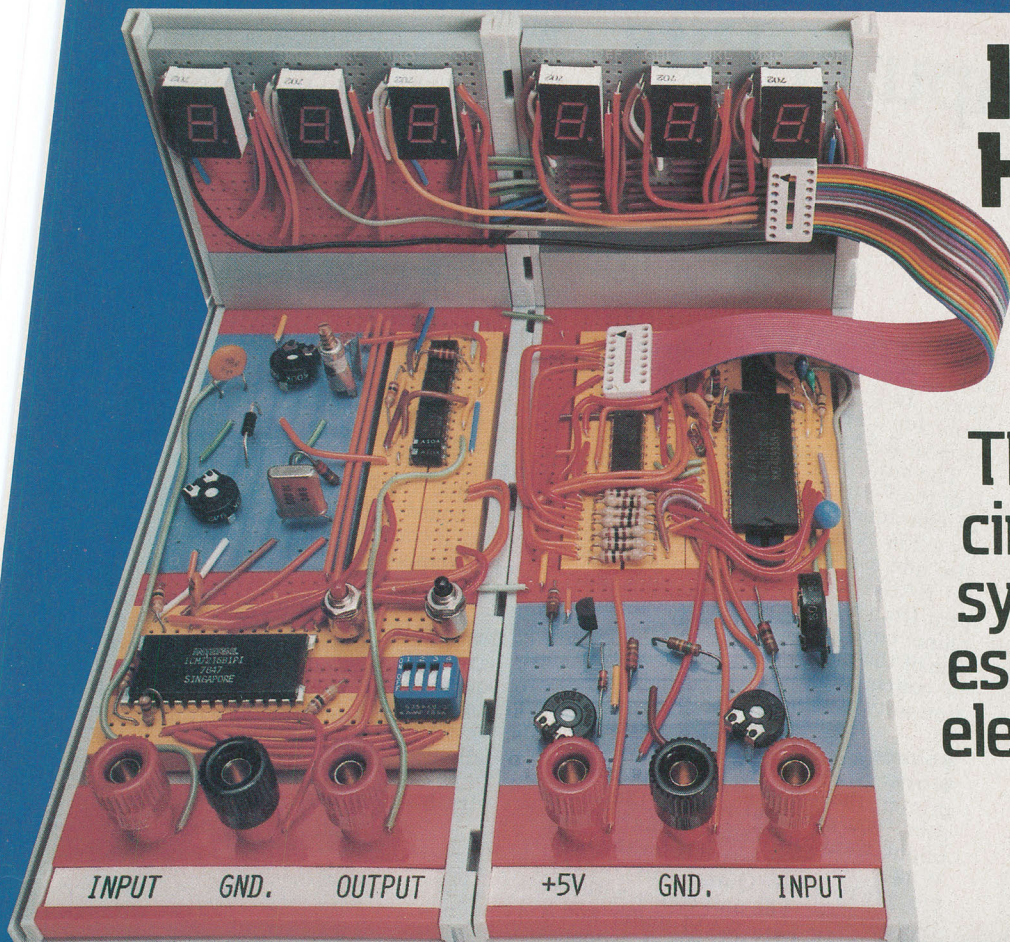
If you're connected to cable TV, the not-yet-available 1980-1981 version would be desirable; if not, the present model beats inflationary increases. Should your interest lie in a larger screen size, General Electric's 1980-1981 25-inch-screen series EM chassis will replace its present YM chassis. The EM chassis uses the cooler-running construction employed in the 19" set just reviewed. Moreover, it will use a ferrononant transformer to provide isolation and a degree of ac voltage regulation, as well as solid-state dc regulators. The company's top-of-line 1980-1981 25" console will include an audio amplifier rated at 10 watts at 0.5% THD for better sound quality.

Of interest, too, is that GE, through stressing burn-in tests for large-quantity production-line samples, says that repair rates on its TV products are down 54 percent in just three years. Also, the company claims it now holds the number 3 U.S. market position, with some 10,000 employees in its TV divisions in Virginia and overseas. —Stan Prentiss.

CIRCLE NO. 102 ON FREE INFORMATION CARD

INTRODUCING HOBBY-BLOX™

The new modular
circuit building
system designed
especially for
electronic hobbyists.



Until now, you had to buy "professional" solderless breadboards for your projects and pay "professional" prices. Now there's Hobby-Blox™, a totally new circuit-building system that's not only economically priced but offers many more advantages to the hobbyist.

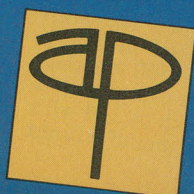
At the core of the system are two expandable starter packs (priced under \$7.00), one for discrete component projects, the other for integrated circuit projects. Each comes with a number of Hobby-Blox modules that fit into a tray and an illustrated project booklet. In addition, the system includes 14 separate component packs you can purchase individually — terminal, distribution and bus strips, speaker panels, binding posts, etc. — priced from \$1.29 to \$3.59.

The Hobby-Blox system is easy to use because the modules are color-keyed and letter/number indexed. It's time-saving, because they're solderless. It's compatible with DIP's of all sizes and a wide variety of discrete components. And you save money, because the parts can be reused again and again.

How far can you go with the Hobby-Blox system? Take a look at the example above. Then you'll know why we say, "your only limit is your own imagination!"

For a free catalog and the name of your nearest Hobby-Blox dealer call toll-free (800) 321-9668.

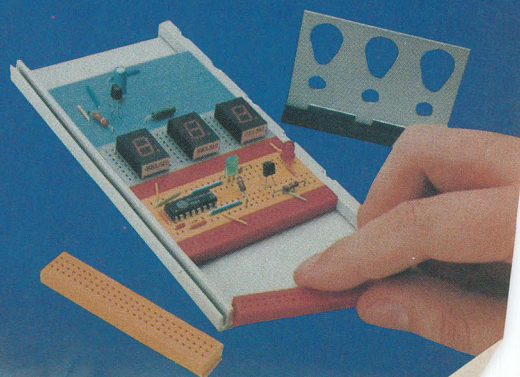
Patents Pending
© A P PRODUCTS INCORPORATED 1980
Prices shown are current suggested U.S. resale.

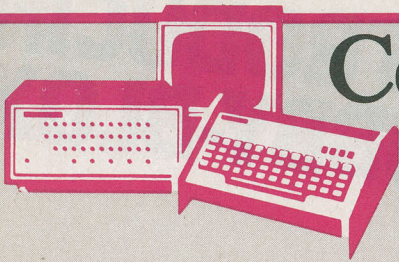


A P PRODUCTS INCORPORATED
1359 West Jackson Street
Painesville, Ohio 44077
(216) 354-2101

In Europe, contact A P PRODUCTS GmbH
Baeumlesweg 21 • D-7031 Weil 1 • W. Germany

CIRCLE NO. 7 ON FREE INFORMATION CARD





Computer Bits

By Carl Warren

New Equipment and Handy Hints

THIS past May, the latest model of Apple computer was introduced to the world. The new model, dubbed the Apple III, is designed for the small business field and, unlike the ubiquitous Apple II which had a base price tag of \$1195, comes for a much healthier \$4400. But look what you get besides expected graphics functions:

- An enhanced 6502 microprocessor that permits addressing up to 128K bytes of memory.
- 96K bytes of RAM, a built-in 5.25-in. floppy disk, a typewriter keyboard with 13-key numeric keypad, a 12-in black-and-white Sanyo monitor, and two built-in printer interfaces.
- What the company terms the Sophisticated Operating System (SOS). Features of this system include an integrated file system, and a device and event management system. Application software consists of Personal Software's Visicalc III, and a Mail list Manager. A Business BASIC is also included.



Apple III includes CPU, disk drive, keyboard, and video monitor.

A Sanyo color monitor, a letter-quality printer, and additional disk drives are also available as options. Customer deliveries of the system began this past June.

Apple isn't the only one making new system introductions. Motorola, has introduced its Exorset 30, a 6809 based machine. It carries a \$5995 price tag and offers some very impressive features. Among these are: two

built-in 5.25-in. floppy disks, a CRT display that can handle both alphanumeric and graphics, programmable timer for a real-time clock, and 48K bytes of RAM.

The built-in CRT on the Exorset 30 is of the 9-in. type and permits a 80×22 character presentation; for graphics a 256×320 dot pattern. You can also add a printer, and a very powerful BASIC is included. It would appear from all indications that this machine could very definitely become one of the major business machines—of course, this assumes full application software support is available.

Boards That Make Things Work. If you have a daisy-wheel printer that does just about everything you need but not all, then you might want the Daisy Brain®, from Wilker, Inc. This board is for the Diablo HyType or Qume daisy-wheel-type printers. The unit comes with 3K ROM, a 2K byte RAM buffer and a Z-80 microprocessor. What it does is give your printer the ability to handle right-margin justification, centering, columns, true proportional spacing, super- and subscripting, bold face, shadow printing, and underlining. The Daisy Brain, also permits both vector plotting and simple user control plotting. The board is priced at \$1100.

Those of you that have the Radio Shack TRS-80 Model I and a yen to make use of the several hundred option boards designed for the S-100 bus will possibly be interested in the 8100 Bus adapter motherboard. Manufactured by California Computer Systems, the 8100 has six S-100 card slots, and a 2-MHz programmable baud rate clock. You will have to contact the company directly about prices since there are a variety of options available.

If you're planning a project where 6-bit A/D conversion at a fast rate is required (in the realm of 33 ns), then TRW LSI has the answer with its latest evaluation board. Called the TDC1014PCB, this board is priced at only \$168 and contains the firm's TDC1014J A/D converter chip. The unit has 63 parallel differential comparators that look at the analog input simultaneously, then compare it with a reference voltage. The comparator outputs are translated into a binary code by means of a 63:6 encoder. This

evaluation board requires a power supply capable of delivering +5 and ± 15 V.

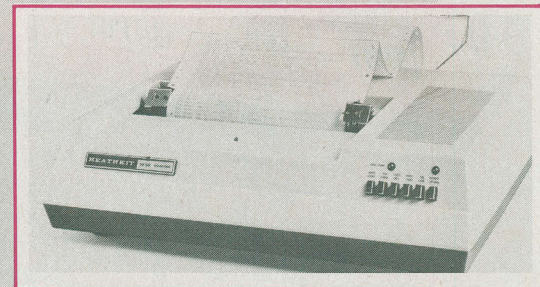
With the current interest in 16-bit microprocessors, it's not surprising to find an S-100 compatible board from Godbout Electronics. But this is not just a board with a single processor; instead, it contains both the Intel 8085 8-bit processor and the Intel 8088 byte-oriented 16-bit processor for only \$295.

What Godbout has done, by implementing the dual processor design, is to give software designers the ability to develop software using the 8-bit 8085, and existing software such as CP/M, and Microsoft's 8080/8086 macro cross-assembler.

Both of the processors run at 5 MHz, and a software switch permits dynamic switching of the processors. This board is not for the beginner, and to use it correctly requires a great deal of understanding of both 8-bit and 16-bit processor operation.

Completing Your System. If you have been bitten by the computer bug, you probably are always in need of that one new item that will just complete your system. The following may fall into your price range and needs.

The H-14 dot-matrix printer from Heath is priced at \$635 kit, or \$895



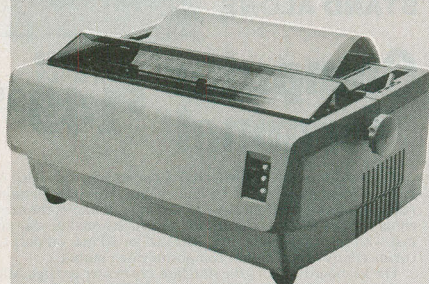
Heathkit H-14 dot-matrix printer has variable baud rate to 4800 bps.

factory built and tested. This unit took me over 30 hours to build and can't be considered a beginner's project. According to Heath, this printer was designed to be a low-cost alternative to higher-priced units.

C. Itoh Electronics, a Japanese trading company, has two entries in the printer family. The first is the Comet 80-column dot matrix printer, priced at \$995, which puts it on a par with most of the units currently being offered. It has a print speed of 125 CPS, bidirectional printing (a not so common feature). The Comet can handle baud rates from 110-9600.

The second unit, called the Starwriter 25 CPS Daisy-wheel printer, is priced at \$2195 (about \$500 less than comparable systems). It can print 136 columns with a pica pitch or 163 with elite. Both printers are manufactured

by Toyko Electric Co. (TEC) for C. Itoh following its specifications, and are available now.

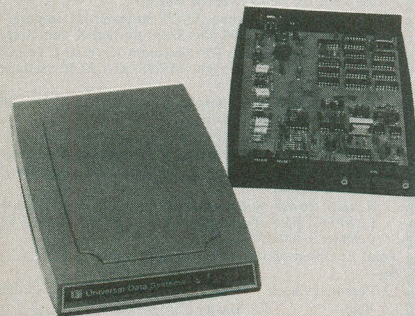


The Starwriter Daisy-wheel printer provides 136 columns of pica type.

C. Itoh also has 5.25- and 8-in. double-sided double-density disk units. The maxi-flexi and mini-flexi line of disk drives are made by Toshiba and have a fairly good reputation as being reliable drives. The 8-in unit sells for \$725, which is about \$25 cheaper than a comparable Shugart drive. The 5.25-in drive is \$450, about the same as a Shugart drive.

In the July "Computer Bits," I mentioned Lobo's winchester package. Well, they have taken it just one step further with a Model 1850 dual fixed/floppy disk memory system. This unit puts the IMI 8-in. winchester drive in the same box as a 1.6M byte floppy. For the configuration of a 10M byte fixed disk drive, double-density floppy, chassis, and power supply, the price is a respectable \$4695. Although this may appear high, it's actually low by about \$1400 compared to similiar systems. The unit, as designed, is for the TRS-80 and Apple computers.

Communications Items. I'm a big proponent of electronic mail, and the benefits it brings to the computer user. I also keep an eye out for those items such as modems, that are a definite must to the use of these systems. One such modem is from Universal Data Systems and is called the 202



Universal 202 LP is a 1200-baud asynchronous communications modem.

LP. The unit is a certified FCC model, which allows for direct connection to the dial-up telephone network with-

MORE INFORMATION

For additional information about products and services mentioned here, contact the companies directly.

Apple Computer, Inc.
10260 Bandley Dr.
Cupertino, CA 95014
408-996-1010

California Computer Systems
250 Caribbean Dr.
Sunnyvale, CA 94086
408-734-5811

CompuServe (MicroNet)
Personal Computing Div.
5000 Arlington Centre Blvd.
Columbus, OH 43220
800-848-8990

C. Itoh Electronics, Inc.
5301 Beethoven St.
Los Angeles, CA 90066
213-390-7778

CompuPro/Godbout Electronics
Bldg. 725, Oakland Airport
Oakland, CA 94614
415-562-0636

Heath Co.
Dept. 010-684
Benton Harbor, MI 49022

Lobo Drives Intl.
935 Camino Del Sur
Goleta, CA 93017
805-685-4546

Micro Peripheral Corp.
Box 529
Mercer Island, WA 98040
206-454-3303 (voice)
206-723-DATA (modem)
70210,205 on MicroNet

Motorola Semiconductor Products Inc.
Box 20912,
Phoenix, AZ 85036
602-962-2209

TRW LSI Products
2525 E. El Segundo Blvd.
El Segundo, CA 90245
213-535-1831

Universal Data Systems
5000 Bradford Dr.
Huntsville, AL 35805
205-837-8100

CONNECTION LISTING 1—BASIC PROGRAM

```

100 REM **CONNECT SAS**
110 REM DICK BARKER 3/21/80
120 REM EXAMPLE OF SETUP AND USE OF THE "CONNECTION"
130 CLEAR 2000
140 DEFINT B,H-Z
150 TM$=STRING$(38," ")
160 '***** SETUP $251 FOR 8 BIT WORD , NO PARITY , 1 STOP BIT
170 OUT 241.7 'SEND IT ANYTHING WITHOUT BIT 6
180 FOR J=1 TO 10: NEXT 'NEED SHORT DELAY
190 OUT 241.64 'SEND RESET
200 OUT 241.78 'MODE SETUP
210 OUT 241.7 'COMMAND INSTRUCTION
220 G=INP(240) 'CLEAN OUT REC BUFFER
230 GOSUB 10000 'SETUP USR ROUTINE IN TM$
240 'FOR DISK SYSTEMS, REPLACE THE FOLLOWING
    LINE WITH DEFUSR=K
245 POKE 16526,PEEK (VARPTR(TM$)+1):POKE 16527,PEEK (VARPTR(TM$)+2)
250 REM SEND DATA TO CONNECTION AS USR ARGUMENT
260 REM GET DATA FROM CONNECTION BY USING ZERO FOR USR ARGUMENT
270 'OUT254.1 'CLOCK SPEEDUP IF INSTALLED

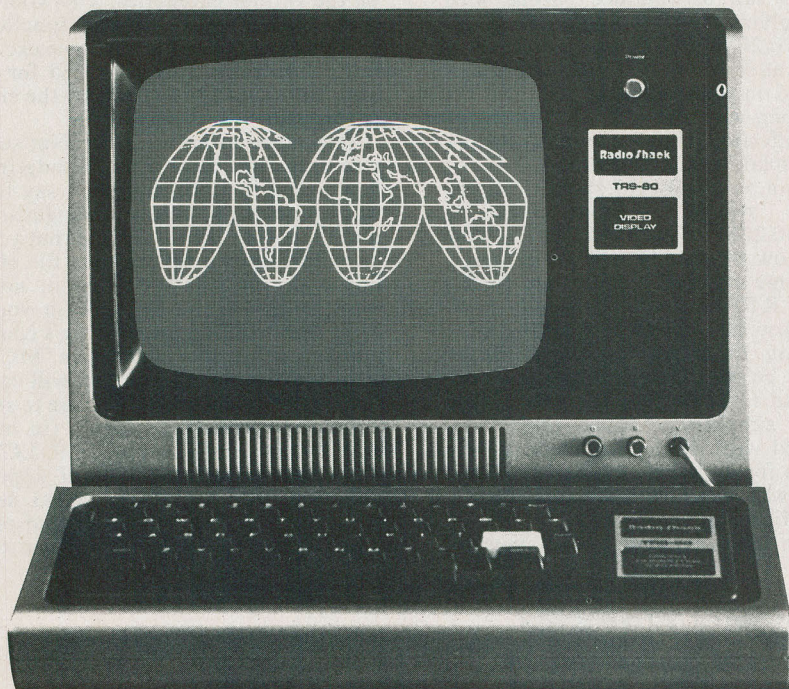
1000 REM **** TERMINAL EXAMPLE ****

1010 CLS:PRINT " SIMPLE TERMINAL PROGRAM FOR THE CONNECTION":
PRINT"USE SHIFTED CHARACTERS FOR CONTROL CHARACTERS":PRINT
1020 I$=INKEY$:I=0:T=96:R=0:O=0:LF=10:PRINTCHR$(14);
1030 REM FOR HALF DUPLEX CHANGE X=USR(I) TO ?CHR$(USR(I));
    ON LINE 1040 IN TWO PLACES.

    PROGRAM LOOPS THROUGH NEXT LINE WHEN RUNNING:

1040 PRINTCHR$(USR(O));:I=0:I$=INKEY$:IFI$<" " THENI=ASC(I$):
IFI>T THENI=I-T:X=USR(I):GOTO1040ELSEX=USR(I):GOTO1040:ELSE1040

9999 REM **** POKE USR ROUTINES TO TM$ ****
10000 X=VARPTR(TM$)+1:A=PEEK(X)+256*PEEK(X+1):
    IFA>32767 THENK=A-65536 ELSE K=A
10001 FOR I=0 TO 37:READ J:POKEK+I,J:NEXT:RETURN
10002 DATA 205,127,10,125,183,40,10,219,241,203
10003 DATA 71,40,250,125,211,240,201,33,0,0
10004 DATA 219,241,203,79,40,5,219,240,230,127
10005 DATA 254,10,40,1,111,195,154,10
10006 END
    
```

CompuServe's information service.

A world of
information
available.
Right now.

If you have a personal computer—or a computer terminal — CompuServe can bring a world of information into your home or small business.

CompuServe

CompuServe is a major computer services company that has been serving top industrial and governmental clients for more than a decade. Now we're also applying our extensive computing capacity to the delivery of information services to your personal computer.

The Information Service

This exciting service is available in more than 250 cities between 6 p.m. and 5 a.m. weekdays, all day weekends and most holidays. Cost? Only \$5.00 per hour billed in minutes. All you need is a 300 baud modem, and our complete information service is only a local phone call away.

Welcome to CompuServe's information service.

- **News. Weather. Sports.** Major regional newspapers. Plus international news services.
- **Finance. MicroQuote.** Updates and historical information on stocks, bonds and commodities.
- **Entertainment.** Theatre, book, movie and restaurant reviews. Plus opera, symphony, ballet, dance, museums, galleries...
- **Electronic Mail.** Create, edit, send and receive messages from any other CompuServe user ... nationwide.

● **Home & Educational Reference Service.** Anything you want to know ... from encyclopedia information to household tips.

● **CompuServe User Information.** In case you need technical help ... and information on new services as they become available.

● **MicroNET.** For the computer hobbyist. Software Exchange, line printer art gallery, challenging games, programming languages, word processing, business & educational programs ... and much, much more.

And this is just the beginning. CompuServe is continually adding to its list of available services. The world of electronic information isn't coming tomorrow. It's here today.

CompuServe is Available at Radio Shack® Stores

Your local Radio Shack® Store Sells CompuServe's information service. There are more than 6,000 Radio Shack® Stores and Dealers nationwide. Check with the outlet nearest you.

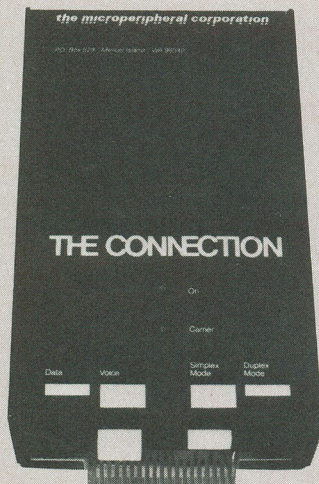
Radio Shack is a division of Tandy Corporation.

CompuServe

Information Service Division
5000 Arlington Centre Blvd.
Columbus, Ohio 43220
(614) 457-8600

out a Data Access Arrangement (DAA). It is only 1.25-in. thick, fits under the telephone, and requires only two snap-in connections. The 202 LP provides 1200-baud half-duplex asynchronous communication for \$295.

Also supporting the use of microcomputers for communication and data acquisition is the Peripheral



Peripheral's Connection is a direct-coupled modem for TRS-80.

people, located in Mercer Island, WA. This small company has developed a \$249 modem, called the Connection®, that turns a 4K Level I TRS-80 into an intelligent remote terminal. This 300-baud model connects to the TRS-80 via the screen printer port and directly to the telephone lines via an FCC type-approved connector.

A very striking and important feature of the Connection is that it is provided with full software support to permit autodialing and data transfer. Also, the folks at Mercer Island have made available (for free) software that can be used to make the Connection, or for that matter any modem, work with general-purpose micros. An example of this software, is shown in Listings 1 and 2.

Listing 1 is a BASIC program for use on a TRS-80, with the Connection. This is ready to run—just type it in and go! Should you have a need to modify it, specifically the user routines in lines 10000-10006, Listing 2 is a complete Z-80 source listing of those data items.

As an added benefit and helpful tool (incidentally you can use this whether or not you engage in telecommunications) is Listing 3. This FIXIT program allows you to add or delete line numbers from a text file. You will find this function important for editing purposes since you can then reference a specific line number for changes. Then, after the text is updated, remove the numbers before submitting the source to an assembler

or a text formatter. All of these programs can be obtained on-line with MicroNet by typing in: DIR [70210,205] FIXIT.BAS. The program as shown in Listing 3 will be displayed on your terminal.

Along with the software and modem offering, the Peripheral People have made available, through MicroNet, an on-line HAM system. To use this system, enter: IRUN [70210,205] HAMGAB.SHR. You will now be able to operate in much the same manner as you would on 20-meter RTTY.

If you have been considering subscribing to MicroNet, but think it might be too difficult to use, you will be glad to know that the service has been simplified. Now users are greeted with a selection menu which allows for a choice of functions, such as news, weather, sports, financial, and MicroNet.

The menu system allows you to

quickly obtain up-to-date information on the various categories. The MicroNet service will, however, function pretty much the same; but some exciting enhancements are planned for it also, and should be in place by the end of this year.

If you are using the MicroNet service now and have been wondering how to get the most out of it, say for word processing, here is a suggestion that may work. First, assume that you have developed a text or data file off-line and, for whatever reason, now want to transfer it to a file in your MicroNet working area. Using a communication package such as MCS from Heath users group, you will call and sign into MicroNet. Be sure to set the correct lower-case option (in my case for an H-89 I, type TER LCT off, which permits entering of upper and lower case characters). Next, set up a file using the File command of: FIL (file name. ext); then return to

CONNECTION LISTING 2—Z-80 SOURCES

```

SCONUSR00100 ; CONBAS/ASM
00300 ; DICK BARKER 3/21/80 COPYRIGHT 1980 MICRO PERIPHERAL
00300 ;DICK BARKER 3/21/80
00400 ;300 BAUD, 8 BIT WORD, NO PARITY, 1 STOP BIT
00500 ;*****
00600 ; THIS IS WRITTEN AS A RELOCATABLE ROUTINE
00700 ;WITH ONLY ONE ENTRY POINT AND MAY BE USED
00800 ;WITH DISK OR NON-DISK LEVEL II MACHINES
00900 ;*****
01000 ;TO SEND A CHARACTER PASS THE ASCII VALUE AS
01100 ;THE ARGUMENT FOR THE USR ROUTINE.
01200 ;*****
01300 ;TO GET A CHARACTER PASS A ZERO TO THE USR
01400 ;ROUTINE. IF NOTHING IN BUFFER A ZERO WILL
01500 ;BE RETURNED, ELSE THE 7 BIT ASCII VALUE
01600 ;WILL BE RETURNED.
01700 ;*****
01800 DPORT EQU 240 ;DATAPORT
01900 SPORT EQU 241 ;STATUS PORT
02000 ORG 8000H
02100 ;*****
02200 ;SEE IF USR WANTS TO SEND OR GET A CHARACTER
02300 ;*****
02400 CALL 0A7FH ;GET USR ARGUMENT IN HL
02500 LD A,L
02600 OR A ;UPDATE STATUS
02700 JR Z,GETCH ;NO CHARACTER TO SEND SO
02800 ;NEED TO GET ONE
02900 ;*****
03000 ;SEND CHARACTER THAT IS IN L REG.
03100 ;*****
03200 B2V IN A,(SPORT)
03300 BIT 0,A ;CHECK TX BUFFER
03400 JR Z,B2V ;WAIT IF BUZY
03500 LD A,L
03600 OUT (DPORT),A ;SENDIT
03700 RET
03800 ;*****
03900 ;GETCHAR ROUTINE FOLLOWS
04000 ;*****
04100 GETCH LD HL,0 ;MAY NEED TO RETURN A NULL
04200 IN A,(SPORT)
04300 BIT 1,A ;CHECK REC BUFFER
04400 JR Z,FIN ;NOTHING THERE
04500 IN A,(DPORT) ;GET CHAR
04600 AND 07FH ;STRIP PARITY
04700 CP 10 ;IS IT A LINEFEED?
04800 JR Z,FIN ;LF NOT WANTED
04900 LD A,A ;VALUE TO RETURN
05000 FIN JP 0A9AH ;BACK TO BASIC
05100 ZEND EQU $
05200 END 402DH

```


Announcing . . . The Phone Ranger

The cordless phone that works like a regular phone up to 300 feet from your house. Use it in your own back yard with our compliments. Keep it, if you wish, for ONLY \$119.95!

I live on five acres. And I keep four horses in my back yard. Used to be, if I got a call while I was down at the corral, one of the kids would yell out the kitchen window and I'd do the hundred-yard dash to the nearest house phone.

No more. With The Phone Ranger I can groom Laird, my Palomino gelding, with one hand and call my broker with the other.

Take or make calls up to 300 feet away.

Maybe you don't keep horses. But if you've got a pool, patio, garden, workshop, tennis court or garage—and you'd like the phone to come to you instead of you going to it—this is the answer.

Try The Phone Ranger for 15 days. Send it back if you want. If you decide to keep it, the best news is the price!

Units that look like toys sell for up to \$495.00!

There's a unit called "ROVAPRO" that looks like my son's toy walkie-talkie—not like a real phone at all—and it goes for a cool \$495.00.

Then there's "MURAPHONE." It's \$149.95. But it's even more like a toy walkie-talkie. You have to push a button to talk and release to listen—with all that "Roger, over to you" stuff in between. Not like a real phone at all.

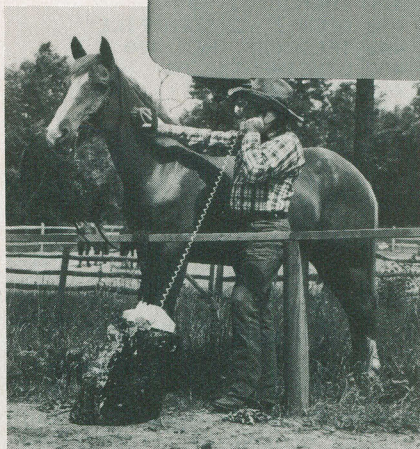
The Phone Ranger looks like a real phone, rings like a real phone, dials out like a real phone . . . has a range of 300 feet . . . and it's only **\$119.95** plus \$5.95 shipping and handling. If you'd prefer a range of a full 750 feet, order the deluxe version for only \$189.95 plus \$5.95 shipping and handling.

Doubles as an extra extension phone.

When you're not using it outside, use it as an extra extension phone without paying monthly charges to the phone company.

Works so simply.

Plug base unit into phone jack and into AC house current. Then plug The Phone Ranger into base unit to charge battery. Now unplug The Phone Ranger and you're ready to use it to take or make calls up to 300 feet away (750 feet if you choose the



deluxe version). Red indicator light tells you when it's time to recharge.



If you don't have a phone jack, the phone company will install one for a nominal one-time charge. If you have an old-fashioned, 4-prong jack, The Phone Ranger comes with an adaptor you can use. Even if you live in an area with rotary dialing, the pushbutton system on your Phone Ranger will work. And the entire unit is FCC approved.

Includes amazing "last number" memory!

No need to re-dial when you get a busy

signal. Just press the # or the * button and The Phone Ranger automatically redials the last number you called!

(A great security idea: "program" your phone to your local police number before you go to bed. The touch of a single button alerts police in case of emergency.)

Pick up your regular phone right now. Here's the number to call . . .

**CALL TOLL-FREE
800-621-5839**

(In Illinois, call 800-972-5858)

For faster service, give this number 15-9500 as soon as the operator answers. Lines are open 24 hours, 7 days a week.

If you're using your credit card, use our toll-free number. If you prefer, send your check to Roy Thomas & Associates, Inc. at the address below. (Illinois residents add 6% sales tax.)

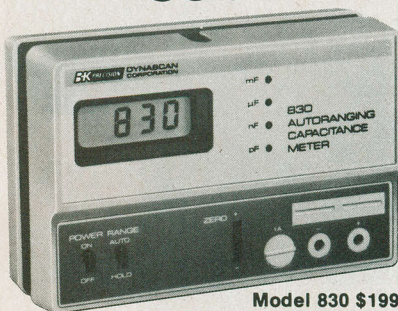
You must be completely satisfied with The Phone Ranger. If for any reason you're not, return it within 15 days for a full refund, no questions asked. Use the carton it comes in to return it.

I know you'll have fun with it. Order now.

**Roy Thomas
& ASSOCIATES, INC.**
733 Lee Street, Dept. 15-9500
Des Plaines, IL 60016

Catch the fastest C-meter under \$200

the autoranging B&K-PRECISION 830



Model 830 \$199
Model 820 \$155 (not shown)

B&K-PRECISION was the first company to offer a lab-quality capacitance meter for under \$150, now we're first with autoranging for under \$200. The new 830 is fast, accurate and built with famous B&K-PRECISION dependability.

The 830 offers features that are tough to match at any price, such as 0.1 pF resolution, large 3½-digit LCD display and fuse protection against charged capacitors. Basic accuracy is 0.2%, much greater than the tolerance of most capacitors. Measurement range extends to 199.9 mF.

Simplicity of operation is another strong suit for the 830. For checks limited to a narrow value range, the "range hold" capability can lock the 830 onto one range—an added time saver. This feature, along with its fast reading time, makes the 830 especially valuable for incoming inspection applications.

For applications suited to manual ranging, B&K-PRECISION offers the LED readout 820 at an even lower cost.

With either B&K-PRECISION C-meter you can, measure unmarked capacitors... verify capacitor tolerance... measure cable or switch capacitance... match capacitors for critical applications... measure complex capacitor networks... set trimmer capacitors.

For more information, contact your local distributor and see why B&K-PRECISION is now the leading supplier of digital capacitance meters.

B&K PRECISION

**DYNASCAN
CORPORATION**

6460 West Cortland Street
Chicago, Illinois 60635 • 312/889-9087

Int'l. Sales, 6460 W. Cortland St., Chicago, IL 60635
Canadian Sales: Atlas Electronics, Ontario

computers

CONNECTION LISTING 3—FIXIT PROGRAM

```
10 REM ** COPYRIGHT 1979 BY THE PERIPHERAL PEOPLE **
20 REM ** FIXIT **
30 CLS: CLEAR 1000: Z$=STRING$(31,""): PRINTCHR$(23)
40 PRINTZ$: PRINTTAB(4)"* * * F I X I T * * *": PRINTZ$: PRINT
50 PRINT"THIS PROGRAM WILL ADD LINE NUM-"
60 PRINT"BERS TO A TEXT FILE OR DELETE"
70 PRINT"THEM FROM AN ASCII SAVED FILE.": PRINT
80 LINEINPUT"FILENAME TO BE CONVERTED? ";X$: PRINT
90 INPUT"ADD (1) OR DELETE (2) NUMBERS";X: IFX<1 OR'X>2 THEN 90
100 CLS
110 OPEN"I".1.X$
120 OPEN"O".2."TEMPFILE"
130 IFX=2THEN200 ELSE 300
200 REM ** DELETE LINE NUMBERS FROM ASCII FILE **
210 IFEOF(1)THEN280
220 LINEINPUT#1,A$
230 ILEFT$(A$,1)<>" " THEN A$=RIGHT$(A$,LEN(A$)-1):GOTO230
240 A$=RIGHT$(A$,LEN(A$)-1)
250 PRINTA$
260 PRINT#2,A$
270 GOTO210
280 GOTO400
300 REM ** ADD LINE NUMBERS TO TEXT FILE **
310 N=10
320 IFEOF(1) THEN 400
330 LINEINPUT#1,A$
340 A$=STR$(N)+" " +A$
350 A$=RIGHT$(A$,LEN(A$)-1)
360 PRINTA$
370 PRINT#2,A$
380 N=N+10
390 GOTO320
400 REM ** REWRITE ORIGINAL FILE **
410 CLOSE 1,2
420 OPEN"O".1.X$
430 OPEN"I".2."TEMPFILE"
440 IFEOF(2) THEN 430
450 LINEINPUT#2,A$
460 PRINT#1,A$
470 GOTO440
480 CLOSE1,2
490 KILL"TEMPFILE"
500 PRINT"NOW, LOAD FILE ";X$;" AND EDIT IT IN THE NORMAL MANNER"
510 PRINT"WITH YOUR TRS-80 EDITOR. WHEN DONE, BE SURE TO SAVE
    THE FILE IN ASCII (<";X$;">".A)".
```

your communication package (for MCS type a control B); then send the file to MicroNet.

You must be sure to return back to MicroNet control and issue an "EX" to save the file. Now the file is available for manipulation in the MicroNet system. As an example of this, this month's column was written and edited off-line, then transferred to MicroNet for formatting via its text processor RUNF10. The processed file, which now has a .DOC extension, was then downloaded to my system and played out on hardcopy. If your concern is over cost, this whole process cost me (and this includes the \$2/hr tymnet charge) about \$3.00. The key here was that most of the work was prepared off-line using the functions of my computer.

If you just want to have some fun with MicroNet, they have implemented a user talk system that is patterned after Citizens Band Radio. You can now monitor pseudo CB channels 1-40 and break in and have a chit-chat. The MicroNet people have also built in a scrambler so you and a

friend can carry on private conversations via your computer.

Information and Fun Books. It's always a good idea to have information resources in your library, and two books that are important to have, are: Radio Shack's *The Engineer's Notebook*, and *Electronics Designer's Casebook No. 3*. The first is written by PE's own Forrest Mims and is a collection of circuits from amplifiers to LED oscilloscopes. This book is available from any Radio Shack store for only \$1.99. *The Designer's Casebook*, is a collection of design projects from *Electronics* magazine from Feb. 16, 1978 to January 4, 1979. This book covers circuits from audio to signal sources and is available from McGraw-Hill for \$5.

Just for fun, Radio Shack has made available, free, a comic book about how a TRS-80 helps Superman save Metropolis. Although the story is a little improbable, so is Superman. It's fun reading and for comic book fans makes an important addition to that priceless collection. ♦

The first personal computer for under \$200.

The Sinclair ZX80.
A complete computer—
only \$199.95 plus \$5.00 shipping.

Now, for just \$199.95, you can get a complete, powerful, full-function computer, matching or surpassing other personal computers costing several times more.

It's the Sinclair ZX80, the computer that independent tests prove is faster than all previous personal computers. The computer that "Personal Computer World" gave 5 stars for 'excellent value.'

The ZX80 cuts away computer jargon and mystique. It takes you straight into BASIC, the most common, easy-to-use computer language.

You simply take it out of the box, connect it to your TV, and turn it on. And if you want, you can use an ordinary cassette recorder to store programs. With the manual in your hand, you'll be running programs in an hour. Within a week, you'll be writing complex programs with confidence.

All for under \$200.

Sophisticated design makes the ZX80 easy to learn, easy to use.

We've packed the conventional computer onto fewer, more powerful LSI chips—including the Z80A microprocessor, the faster version of the famous Z80. This makes the ZX80 the world's first truly portable computer (6½" x 8½" x 1½" and a mere 12 oz.). The ZX80 also features a touch sensitive, wipe-clean keyboard and a 32-character by 24-line display.

Yet, with all this power, the ZX80 is easy to use, even for beginners.



Your course in computing.

The ZX80 comes complete with its own 128-page guide to computing. The manual is perfect for both novice and expert. For every chapter of theory, there's a chapter of practice. So you learn by doing—not just by reading. It makes learning easy, exciting and enjoyable.

The ZX80's advanced design features.

Sinclair's 4K integer BASIC has performance features you'd expect only on much larger and more expensive computers. These include:

- Unique 'one touch' entry. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry and are stored as a single character to reduce typing and save memory space.
- Automatic error detection. A cursor identifies errors immediately to prevent



entering programs with faults.

- Powerful text editing facilities.
- Also programmable in machine code.
- Excellent string handling capability—up to 26 string variables of any length.
- Graphics, with 22 standard symbols.
- Built-in random number generator for games and simulations.

Sinclair's BASIC places no arbitrary restrictions on you—with many other flexible features, such as variable names of any length.

And the computer that can do so much for you now will do even more in the future. Options will include expansion of 1K user memory to 16K, a plug-in 8K floating-point BASIC chip, applications software, and other peripherals.

Order your ZX80 now!

The ZX80 is available only by mail from Sinclair, a leading manufacturer of consumer electronics worldwide. We've already sold tens of thousands of units in Europe, so demand will be great.

To order by mail, use the coupon below. But for fastest delivery, order by phone and charge to your Master Charge or VISA. The ZX80 is backed by a 30-day money-back guarantee, a 90-day limited warranty with a national service-by-mail facility, and extended service contracts are available for a minimal charge.

Price includes TV and cassette connectors, AC adaptor, and 128-page manual.

All you need to use your ZX80 is a standard TV (color or black and white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)



The ZX80 is a family learning aid. Children 10 and above will quickly understand the principles of computing—and have fun learning.

Phone orders: (203) 265-9171. Mon.-Fri. 8 AM-6 PM EST. We'll deduct the cost of the call from your invoice. (For technical information, call (617) 367-2555, Mon.-Fri. 9 AM-5 PM EST.)

sinclair

Sinclair Research Ltd., 475 Main St.,
P.O. Box 3027, Wallingford, CT 06492.

To: Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.

Please send me _____ ZX80 personal computer(s) at \$199.95* each (US dollars), plus \$5 shipping. (Your ZX80 may be tax deductible.)

I enclose a check/money order payable to Sinclair Research Ltd. for \$_____.

Name _____

Address _____

City _____ State _____ Zip _____

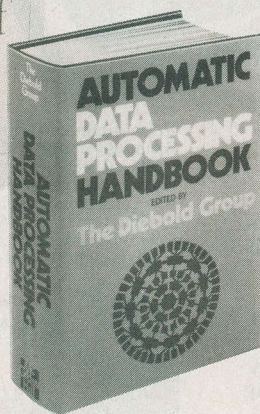
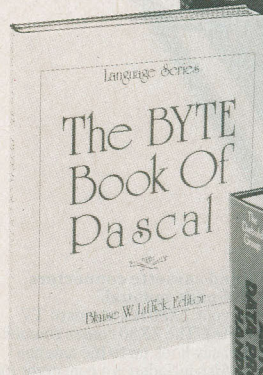
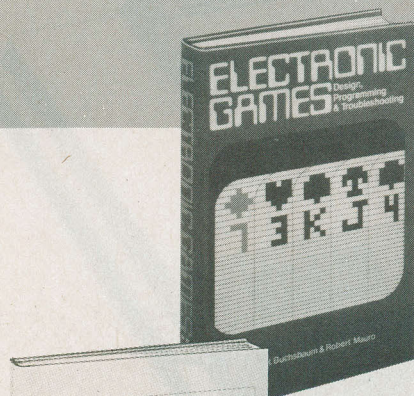
Occupation: _____ Age: _____

Intended use of ZX80: _____

Have you ever used a computer? ☐ Yes ☐ No.

Do you own another personal computer? ☐ Yes ☐ No. *For Conn. deliveries, add 7% sales tax.

BUY ONE of these great professional books when you join the

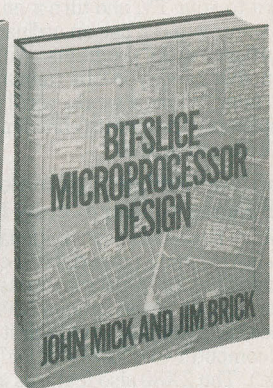
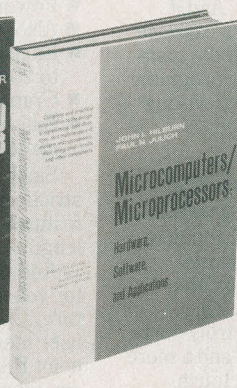
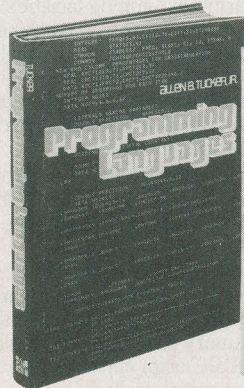


MINICOMPUTER SYSTEMS, Organization, Programming, and Applications. By Richard H. Eckhouse, Jr. and L. Robert Morris. 2nd Ed., 491 pp., illus. Updated, revised, and expanded, this is a book for every systems programmer, systems designer, computer scientist, and application specialist who wants to know more about microcomputer hardware, software, and design. 787/026 Pub Pr., \$21.95 Club Pr., \$17.75

MICROELECTRONICS: Digital and Analog Circuits and Systems. By Jacob Millman. 801 pp., 700 illus. Exciting news for the thousands of engineers who want a thorough refresher and updating on today's ICs. Will be welcomed by both digital and analog electronics engineers at every level of proficiency. 423/27X Pub. Pr., \$28.95 Club Pr., \$22.50

AUTOMATIC DATA PROCESSING HANDBOOK. Edited by The Diebold Group. 976 pp., 269 illus. Written by a staff of internationally recognized authorities on ADP, this comprehensive handbook explains systems, programming and the languages, communications processes, and the design and installation of today's computers. 168/075 Pub Pr., \$44.95 Club Pr., \$31.50

THE BYTE BOOK OF PASCAL. Edited by Blaise W. Liffick. 340 pp., illus. Here's a treasury of up-to-date Byte articles on PASCAL—from a general introduction of system hardware. Includes two versions of a PASCAL compiler, a p-code interpreter written in both PASCAL and 8080 assembly language, a chess-playing program, an APL interpreter, and more. 789/673 Pub. Pr., \$25.00 Club Pr., \$19.95



BE SURE TO CONSIDER THESE IMPORTANT TITLES AS WELL—

APPLYING MICROPROCESSORS, New Hardware, Software, and Applications. Edited by L. Altman & S. E. Scrupski. 191/603 Pub. Pr., \$23.50 Club Pr., \$18.95

57 PRACTICAL PROGRAMS & GAMES IN BASIC. By K. Tracton. 784/957 Pub. Pr., \$10.95 Club Pr., \$9.30

MICROPROCESSOR ARCHITECTURE AND PROGRAMMING. By W. F. Leahy. 784/612 Pub. Pr., \$24.50 Club Pr., \$18.50

16 BIT MICROPROCESSOR ARCHITECTURE. By T. Dollhoff. 582003-X Pub. Pr., \$24.95 Club Pr., \$19.95

THE BASIC COOKBOOK. By K. Tracton. 786/615 Pub. Pr., \$7.95 Club Pr., \$6.75

MICROPROCESSOR PROGRAMMING FOR COMPUTER HOBBYISTS. by N. Graham. 783/56X Pub. Pr., \$12.95 Club Pr., \$10.95

DISTRIBUTED MICRO/MINICOMPUTER SYSTEMS. By C. Weitzman. 789/622 Pub. Pr., \$22.50 Club Pr., \$18.25

HOME COMPUTER PROGRAMS. By J. W. Trudell, Jr. & M. Landberg. 787/042 Pub. Pr., \$8.95 Club Pr., \$7.60

FUNDAMENTALS OF COMPUTER ALGORITHMS. by E. Horowitz & S. Sahni. 786/380 Pub. Pr., \$22.95 Club Pr., \$18.25

ELECTRONICS DICTIONARY. By J. Markus. 404/313 Pub. Pr., \$24.50 Club Pr., \$19.50

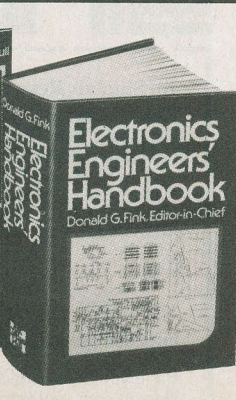
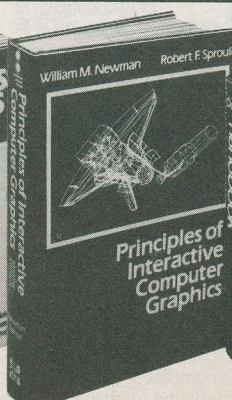
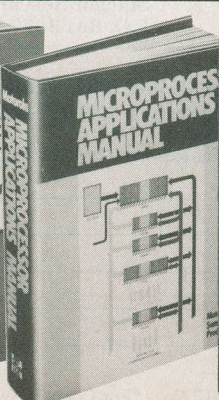
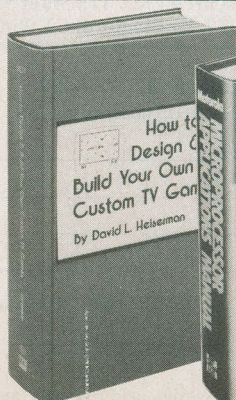
BIT-SLICE MICROPROCESSOR DESIGN. By John Mick and Jim Brick. 398 pp. All in one place—the crucial information you've been needing about the 2900 family of bit-slice microprocessor components. This remarkable "first" designs right before your eyes not just one but two complete 16-bit machines! 417/814 Pub. Pr., \$18.50 Club Pr., \$14.50

PRINTED CIRCUITS HANDBOOK. Edited by C. F. Coombs, Jr. 2nd Ed., 634 pp., 595 illus. Covering the subject of printed circuits from the design's idea to final acceptance, this enormously well-received work includes double-sided plated boards through printed boards and also the major variations such as multilayer and flexible circuits. 126/089 Pub. Pr., \$32.50 Club Pr., \$24.50

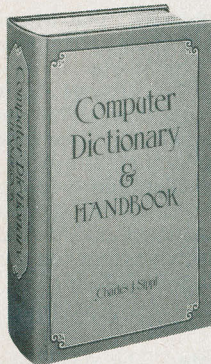
PRINCIPLES OF INTERACTIVE COMPUTER GRAPHICS. By William M. Newman and Robert Sproull. 2nd Ed., 544 pp., illus. Now in a revised, updated Second Edition, this is a volume that has long been THE standard source of information for designers! 463/387 Pub. Pr., \$24.95 Club Pr., \$19.95

ELECTRONICS ENGINEERS' HANDBOOK. Editor in Chief, D. G. Fink. 2,104 pp., 2026 illus. Brings together in one instant-reference volume the essential principles, data, and design information known today on the components, circuits, equipment, and systems of all the various specialties that make up modern electronics. 209/804 Pub. Pr., \$57.50 Club Pr., \$40.50

THE 8080A BUGBOOK: Microcomputer Interfacing and Programming. By Peter R. Rony, David G. Larsen, and Jonathan A. Titus. 416 pp., with figures, charts, and tables, paperbound. Gives you the basic concepts of microcomputer interfacing and the associated microcomputer I/O programming to develop your own interfaces. For the 8080 user, this book will be invaluable. 783/845 Pub Pr., \$9.95 Club Pr., \$8.45



and GET ONE FREE (values up to \$60.00) COMPUTER PROFESSIONALS' BOOK CLUB



COMPUTER DICTIONARY AND HANDBOOK. By Charles and Robert Sippl. 624 pp., illus. This handy reference/guide defines and explains a wide range of computer procedures, products, problems, and applications. Appendixes provide a "state-of-the art" guide to essential computer concepts.
582079-X Pub. Pr., \$29.95 Club Pr., \$24.95

ELECTRONIC GAMES, Design, Programming and Troubleshooting. By W. H. Buchsbaum and R. Mauro. 335 pp., 338 illus. Information you need to design, program, and troubleshoot electronic games is right here in this widely popular hands-on guide.
087/210 Pub. Pr., \$21.50 Club Pr., \$16.50

MEMORY DESIGN: Microcomputers to Mainframes Edited by LAURENCE ALTMAN. 192 pp., illus., 8 1/2 x 11 format Keep "up" with memory chips through this collection of key articles from *Electronics* magazine. Data, diagrams, and discussions put all the technology to work for you in one authoritative book—a volume so up to date it's a pleasure to use.
191/549 Pub. Pr., \$22.50 Club Pr., \$17.95

PROGRAMMING LANGUAGES. By Allen B. Tucker, Jr. 439 pp., illus. Gives you not only the principles of design but the applications of six major programming languages. Shows you their strengths and weaknesses in solving various representative "benchmark" problems.
654/158 Pub. Pr., \$23.95 Club Pr., \$16.95

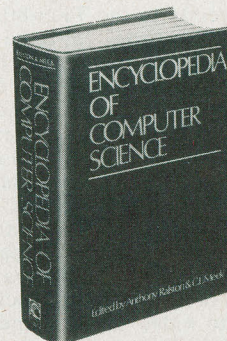
MICROCOMPUTERS/MICROPROCESSORS Hardware, Software, and Applications. By John L. Hilburn and Paul N. Julich. 372 pp., illus. Expressly created for people involved in the design, use, or maintenance of digital systems using microcomputers. The authors describe the theory and workings behind microprocessor architecture, read-only memory (ROM), random-access memory (RAM), and input/output interfacing methods.
771/449 Pub. Pr., \$22.50 Club Pr., \$16.50

LOGIC DESIGNER'S MANUAL. By John D. Lenk. 504 pp., illus. Written for logic IC users rather than for designers of logic ICs, this book uses time-tested existing commercial logic ICs to solve all design and application problems.
784/671 Pub. Pr., \$18.95 Club Pr., \$15.75

HOW TO DESIGN AND BUILD YOUR OWN CUSTOM TV GAMES. By David L. Heiserman. 544 pp., illus. Shows you how to create and build TV games from scratch and modify the ones you already have.
786/585 Pub. Pr., \$14.95 Club Pr., \$11.95

MICROPROCESSOR APPLICATIONS MANUAL. By Motorola Semiconductor Products, Inc. 720 pp., illus., 8 1/2 x 11 format. With nuts-and-bolts practicality, this manual by the Motorola people (who should know) gives you detailed applications information on microprocessors and assumes no prior knowledge on your part about MPUs.
435/278 Pub. Pr., \$38.00 Club Pr., \$26.50

PERSONAL COMPUTING: Hardware and Software Basics ELECTRONIC BOOK SERIES. 224 pp., 175 illus., outsized 8 1/2 x 11 format Gives you comprehensive guidance to the present state of the art in personal computers—an overall survey of the technology, and methods available to perform various tasks, facts about the work others are doing—and just how they are doing it.
191/514 Pub. Pr., \$19.50 Club Pr., \$15.50



ENCYCLOPEDIA OF COMPUTER SCIENCE. Edited by Anthony Ralston and C. L. Meek. 1,500 pp., 60 illus., 100 charts, 7 x 10 format. This first and only in-depth coverage of the entire field of computer science in a single volume is comprehensive and completely up to date.
769/01X Pub. Pr., \$60.00 Club Pr., \$39.95

ANALOG SYSTEMS FOR MICROPROCESSORS AND MINICOMPUTERS. By Patrick H. Garrett. 248 pp., illus. Explores all possibilities for analog systems in one applications oriented volume—with many specific examples.
786/496 Pub. Pr., \$18.95 Club Pr., \$14.95

Choose any one of these books at the special club discount, and select any other as your gift Free of Charge when you enroll

Why YOU should join now!

- **BEST BOOKS IN YOUR FIELD**—Books are selected from a wide range of publishers by expert editors and consultants to give you continuing access to the latest books in your field.
- **BIG SAVINGS**—Build your library and save money too! We guarantee savings of at least 15% off publishers' list prices on every book. Usually 20%, 25% or even higher!

• **BONUS BOOKS**—You will immediately begin to participate in our Bonus Book Plan that allows you savings between 70-80% off the publisher's price of many books.

- **CONVENIENCE**—14 times a year you receive the Club Bulletin FREE, fully describing the Main Selection and alternate selections, together with a dated reply card. If you want the Main Selection, you simply do nothing—it will be shipped automatically. If you want an alternate selection—or no book at all—you simply indicate it on the regular reply card and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the Bulletin you should receive a book you do not want, just return it at the Club's expense.

As a Club member, you agree only to the purchase of four books (including your first selection) over a two-year period.

Computer Professionals' Book Club

P.O. Box 582, Hightstown, New Jersey 08520

Please enroll me as a member and send me the two books indicated, billing me for my first selection only at the discounted member's price, plus local tax, postage and handling. If not satisfied, I may return the books within 10 days and my membership will be canceled. I agree to purchase a minimum of 3 additional books during the next 2 years as outlined under the club plan described in this ad. Membership in the club is continuous but cancellable by me any time after the four book purchase requirement has been fulfilled.

Write Code # of
FREE selection here

Write Code # of
FIRST selection here

Orders from outside the U.S. must be prepaid with international money orders in U.S. dollars.

Charge my ☐ VISA ☐ MASTER CHARGE* Exp. Date _____

Credit Card # _____ *MC Bank # _____

Signature _____

Name _____

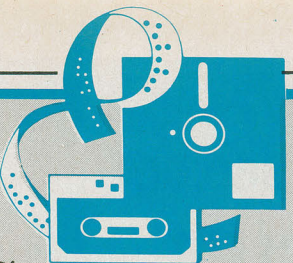
Address _____

City, State, Zip _____

Corporate Affiliation _____

This order subject to acceptance by McGraw-Hill. All prices subject to change without notice. Offer good only to new members. A postage and handling charge is added to all shipments.

P39466



Computer Sources

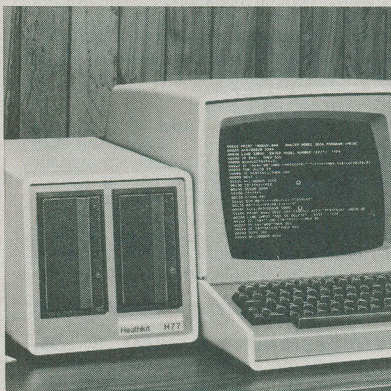
By Leslie Solomon
Senior Technical Editor

Hardware

TRS-80 STD Bus. The Hartmann-Lang TRS-80/STD bus peripheral connects directly to the TRS-80, and allows all STD bus devices to be used with this popular machine. Hartmann-Lang makes available a 6-slot STD bus motherboard; 16-channel 10- and 12-bit A/D converters; 4-channel, 12-bit DAC; 8-channel reed-relay output; 8-channel triac output; 8-port I/O; 44K dynamic RAM; 16K static RAM; 16K EPROM; parallel interface for line printer compatible with TRS-80 software; and various breadboard cards. Software includes hex dump to video (source and object), cassette dump to video, decimal/ASCII dump to video in BASIC, hex to decimal to hex conversion in

BASIC, monitor, single step for TBUG, relocater for TBUG, 6502 emulator with disassembler, and cassette tape utility. Address: Hartmann-Lang, Box 693, Chatham, NJ 07928.

Heath Floppy Accessory. The Heathkit H-77 Floppy Disk System is an accessory for the H89 All-In-One computer from this company. When used, three floppy disk drives are available with their extended storage



space. The new accessory uses 5.25-inch, hard-sectored, 40-track diskettes, each capable of storing 100K bytes of data. The Siemens 82 disk drive is used; typical random sector access time is less than 250 millisec-

onds. Kit price with one disk drive is \$595, with the second drive at \$325. Factory assembled and tested with two drives the WH-87 system is \$1195. The H-88-6 Adapter kit at \$50 is required to install the WH-87. Address: Heath Company, Benton Harbor, MI 49022.

S-100 I/O Board. The Multi-I/O board, an S-100 plug in, contains two independent sync/asynch serial ports with RS232 or 20-mA, one strobed 8-bit parallel port, three 8-bit parallel ports user configured, three independent 16-bit timers, an 8-level priority interrupt controller, and two software programmable baud rate generators. All ICs are socketed. \$375. Address: I/O, Box 2119, Canyon Country, CA 91351 (Tel: 805-252-7666).

Analog Apple. The AI-02 Analog Input card for Apple II computers monitors 16 analog channels with 8-bit resolution. Channels are individually addressable and conversion time is 70 microseconds. The system can be operated from BASIC. The AO-03 Analog Output card is available in 2-, 4-, or 8-channel configurations. This card accepts an 8-bit quantity (0 to 255) and produces an output of 0 to 10 or -5 to +5 volts (jumper selectable). This card, together with the Analog Input card provides a control and measurement facility for the Apple. Address: Interactive Structures, Inc., Box 404, Bala Cynwyd, PA 19004 (Tel: 215-667-1713).

JBL's new L112.

Lower, higher, faster, flatter.

Introducing the L112. The result of years of research at the leading edge of transducer engineering.

Lower. The L112's Symmetrical Field Geometry 12" woofer delivers the low notes of music with extremely low distortion.

Higher. A new Dome Radiator was developed through the use of laser holography. You'll hear harmonics you've never heard before.

Faster. JBL's new High Resolu-

tion Dividing Network enables the L112 to deliver transients with startling immediacy.

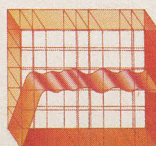
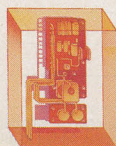
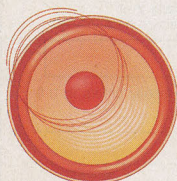
Flatter. The flat frequency response measurements of the L112 qualify this speaker as the most accurate bookshelf performer we've tested.

Listen to musical reproduction at technology's leading edge. At your JBL dealer.

James B. Lansing Sound, Inc., 8500 Balboa Blvd., Northridge, CA 91329.

JBL

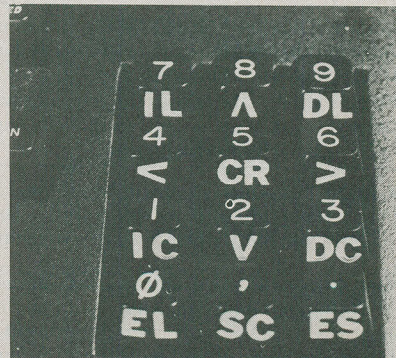
JBL First with the pros.



© 1980 James B. Lansing Sound, Inc.

CIRCLE NO. 40 ON FREE INFORMATION CARD

Hazeltine 1500 Editing. A firmware modification using a ROM that is plugged into a Hazeltine 1500 Terminal converts the latter's numeric keypad into a screen-editing pad. This allows the user to control up, down, left, and right cursor; insert and delete a character in a line; insert and delete a line; erase to end of line/screen; and block transmit of a single line up to 80



characters in length. Toggling between normal and editing modes is via the SHIFT key. Visual inspection of the cursor indicates mode with a triangular cursor for normal mode and a block cursor for block operation.

ROM, stick-on labels for keys, and user manual are \$100. Address: Koch Computing Inc., Box 160478, Miami, FL 33116. (Tel: 305-595-5491).

Commodore Floppy. The CBM 2030 Series are 5 1/4" floppy disk drives that can handle 130K bytes of storage, and can be upgraded in the field to a dual-drive version for 260K bytes. They are compatible with any PET or CBM computer. The CBM 2030 cabinet, which can house two drives, measures 13 1/2" X 8" X 6 1/2". The single-drive CBM 2031 is \$595. Address: Commodore Business Machines, Inc., 3330 Scott Blvd., Santa Clara, CA 95051 (Tel: 408-727-1130).

S-100 21-Card Cage. Model CCK100 holds 21 S-100 cards on 3/4" centers and is fabricated from 0.081" anodized aluminum sidewalls and extruded cross members. An S-100 motherboard can be mounted on the rear. It measures 19" wide, 12.2" high, and 8.9" deep. The adjustable cross members accommodate circuit boards from 4" to 8" long, and from 10" to 11.5" wide. The snap-in plastic guides may be placed on centers with multiples of 0.25". With the guides placed on 0.5" centers, 31 cards can be accommodated. Space is available for a front panel or a fan. With 21 pairs of card guides, the cage is \$49.80. Address: Vector Electronic Co., 12460 Gladstone Ave., Sylmar, CA 91342. (Tel: 213-365-9661).

Software

Atari Educational Software. A series of educational programs for grades 1 through 6, written for the Atari 400 and 800, is now available. These include Guessword (grades 6 and above), Fishing for Homonyms (grades 3-6), Wanted (grades 4-8), Word-Mate (grades 3-6), and Word Scramble (grades 1-4). On cassette with study guide. Address: THESIS, Box 147, Garden City, MI 48141 (Tel: 313-595-4722).

TRS-80 Editor/Assembler. The Editor/Assembler-Plus, is said to provide all the features of the Radio Shack Editor/Assembler and T-Bug, as well as the ability to assemble directly into memory, conditional assembly and macro facility. It also includes expression evaluation, automatic origin, improved symbol table, printout and quash command and other enhancements. The Z-Bug, in addition to the existing T-Bug, allows

eight breakpoints, single step execution, direct execution in the calculator mode, and symbolic references among other features. Editing features MOVE, COPY, SUBSTITUTE, EXTEND, EDIT and FIND. It requires Level-II BASIC and 16K of RAM. Cassette and manual is \$29.95. Address: Microsoft Consumer Products, 10800 Northeast Eighth, Suite 819, Bellevue, WA 98004 (Tel: 206-454-1315).

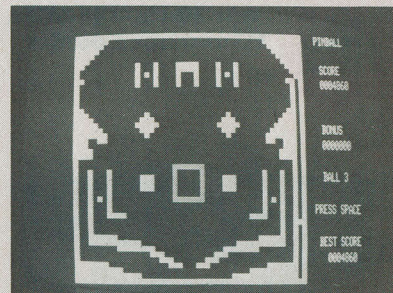
CP/M Master Catalog. This system can keep track of all files on any diskette in use. It produces a listing of all file names in alphabetic order, and the name of the diskette containing that file. Selective listings may also be made in a manner similar to that used by CP/M "DIR" command. Besides sorting the directory in alphabetic order, the system also removes non-"ERA"-able files. Also included are two programs that list the directory in three or four columns with each file size and the available space left on the diskette. Source and object program, \$10. Address: Elliam Associates, 24000 Bessemer St., Woodland Hills, CA 91367.

6502/6800 Cross Assemblers. The XASM65 and XASM68 are cross assemblers that can be used on 8080/8085/Z80 machines using CP/M. Each assembler supports the microprocessor manufacturer's mnemonics and will supply a symbol table and paginated listings. Complete range of pseudooperations make conditional assemblies and test "includes." These pseudooperation commands handle complete arithmetic expression (addition, subtraction, multiplication, division) and Boolean operations (shift, and, or, etc.). \$200. Address: Lifeboat Associates, 2248 Broadway, New York, NY 10024 (Tel: 212-580-0082).

Transistor Design. Available on a North Star single-density diskette, SPDES uses NS BASIC and is an interactive program for the design of small-signal r-f transistor amplifier circuits. Given the two-port scattering matrix measured at a single frequency, and at a given dc bias level, the program computes the stability factor and, if stable, calculates maximum gain, optimum load and source reflection coefficient; converts reflection coefficient to impedance; and computes single-frequency micro-stripline matching for the device with a resistive load and source impedance. If potentially unstable, the program computes the parameters of the source and load stability circles and, for a specified gain, the parameters of the gain circle. You can use a Smith Chart at this point, or the program will compute all load reflection coefficient points on the gain circle and de-

termine if the load is in the stable area of the load stability circle. If the load is stable, the program calculates the source reflection coefficient. The program will then calculate the impedance values of the load and source reflection coefficient. Given the stripline parameters, a series and shunt stripline matching network will be calculated for the desired gain at a single frequency. \$45. Address: Kask Labs, 1207 E. Secretariat Dr., Tempe, AZ 85284.

TRS-80 Pinball. Pinball is a real-time game written in machine language. It includes flippers, bumpers, rollovers, runs, and bonus points. Once in play, both ball speed and ac-



celeration depend on the contact with the various elements including the "Bermuda Square." Full graphics are used. Cassette is \$14.95, diskette is \$20.95. Address: Acorn Software Products, Inc., 634 North Carolina Ave., S.E., Washington, DC 20003 (Tel: 202-544-4259).

New Radio Shack Releases. Radio Shack has recently released three new pieces of software for its TRS-80 machines. One is K-8 Math supplied in five cassettes and three disks in a binder with teacher's manual and record-keeping forms. Designed for kindergarten to 8th grade, the program features hundreds of different math problems with automatic grading. Requires a 16K Level II. \$199. SCRIP-SIT is a full-feature word processor. In conjunction with a special "control" key and 14 regular keys, it allows moving of words or paragraphs, insert, delete, or edit of material. Press-on key labels are provided. Document chaining allows merging, inserting, and other text operations. Automatic page numbers, page headings, footnotes, paragraph indent, changes in line width, and centered text are features. Requires TRS-80 Model I 16K Level II and Line Printer II or WP-50 daisy-wheel printer. \$69.95 for tape, \$99.95 for disk. The third, Radio Shack COBOL, includes a one-pass compiler that generates an object code for direct execution, full-screen formatting, full ANSI Level 2 I/O, program linkage and segmentation. It is \$299 from Radio Shack Stores and Computer Centers. ♦

Heath/Zenith Instruments:



Heath/Zenith instruments are professional units that give you good value for your money. A wide selection to let you choose the unit with the features you need — without paying for a lot of bells and whistles you don't. Manufactured to strict Heath/Zenith standards. Inspected at every step of assembly to assure performance to specifications. They're built to last; built to give

you reliable service. 61 U.S. and Canadian locations offer service, should it ever be necessary. Whether you need a test instrument for electronics service work, manufacturing and design, or serious hobby applications, Heath/Zenith instruments are a good choice. The selection offered here is just part of our total instrument line. Order TOLL FREE 800-253-0570.

NEW

New 10 Hz-225 MHz Frequency Counter



\$159⁹⁵

- 10 mV typical sensitivity
- Single input gives entire range
- Crystal-controlled time base
- 0.1, 1.0 second dual time gates
- Full voltage protection
- Easy-to-read 8-Digit display
- 3.38" H x 7.25" W x 9.0" D

SM-2410 159.95
(\$2.30 shipping & handling)
SMA-2400-1, Antenna 9.95
(\$1.60 shipping & handling)

NEW

New 5 Hz-512 MHz Frequency Counter



\$299⁹⁵

- Ideal for 2-way UHF work
- Ovenized, high-stability, crystal timebase
- 8-Digit resolution
- 10 mV typical sensitivity
- .01, .1, 1, 10 second gate times to fit your needs
- Trigger level control
- Frequency ratio function
- Period function
- 4.25" H x 10.0" W x 13.0" D

SM-2420 299.95
(\$2.75 shipping & handling)
SMA-2400-1, Antenna 9.95
(\$1.60 shipping & handling)

NEW

New Hand-held 512 MHz Counter



\$179⁹⁵

- Easy-to-read 7-digit display
- 10 mV typical sensitivity
- Includes nickel-cadmium batteries
- AC or battery operation
- .1 second and 1 second time gates with automatic decimal point placement
- Leading zero blanking
- Crystal-controlled time base
- Full voltage protection
- 2.0" H x 3.38" W x 8.25" D

SM-2400 179.95
(\$1.90 shipping & handling)
PS-2404 120V Battery Eliminator/Charger (required) 4.95
(\$1.60 shipping & handling)
PS-2405 240V Battery Eliminator/Charger (required) 12.95
(\$1.60 shipping & handling)
SMA-2400-1 Telescopic Antenna 9.95
(\$1.60 shipping & handling)

Hand-held Multimeter gives 0.1% accuracy

\$129⁹⁵

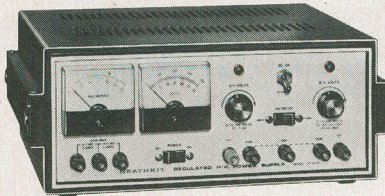
- Measure voltage, current, resistance
- Easy-to-read Liquid Crystal Display
- Five DC voltage ranges — 200mV-1000V
- Five AC voltage ranges — 200mV-750Vrms
- Four DC current ranges — 2mA-2000mA
- Four AC current ranges — 2mA-2000mA
- Six resistance ranges — 200 Ω-20 MΩ
- Uses one 9V battery or 120/240 VAC
- 2.0" H x 3.5" W x 7.5" D

SM-2215 129.95
(\$1.75 shipping & handling)
IMA-2215-1 Leather Carrying Case .. 14.95
(\$1.60 shipping & handling)
PS-2350 120VAC Battery Eliminator .. 4.95
(\$1.60 shipping & handling)
PS-2450 240VAC Battery Eliminator .. 14.95
(\$1.60 shipping & handling)



professional quality, excellent value

General-purpose Power Supply



\$210⁰⁰

- Supplies B+, C- and filament voltages
- 0-400 VDC output at 0-100 mA continuous (125 mA intermittent)
- Output variation less than 1% from no load to full load for 100-400VDC
- Ripple less than 10 mVrms
- Output impedance 10 Ω from DC-1 MHz
- C- Voltage 0 to -100 VDC at 1mA
- Filament voltage 6.3 VAC at 4 amp.
- 5.5" H x 13.38" W x 11.25" D

SP-2717 210.00
(\$4.40 shipping & handling)

Tri-Power Supply



\$185⁰⁰

- Fixed 5 VDC at 1.5A and two continuously-adjustable 0-20 VDC at 500mA
- Interconnect outputs in any combination
- Clutch-coupled 20 VDC supplies for dual-tracking operation
- All outputs short-circuit proof
- Ripple and noise less than 5 mVrms
- Load or live regulation provides less than 0.1% (20 mV) variation on 20V supplies and less than 2% variation on 5V supply
- 4.5" H x 10.75" W x 9.0" D

SP-2718 185.00
(\$3.15 shipping & handling)

Sine-square wave Audio Generator



\$185⁰⁰

- 1 Hz-100 kHz frequency range
- 0.003-10 Vrms sine wave output (10k Ω load)
- 0.003-1 V sine wave output (600 Ω load)
- Meter calibrated in volts and dB
- -62 to +22 dB ranges
- 0.1-10 V square wave output (2000 Ω load)
- 50 nanosecond risetime
- 5.13" H x 13.25" W x 7.0" D

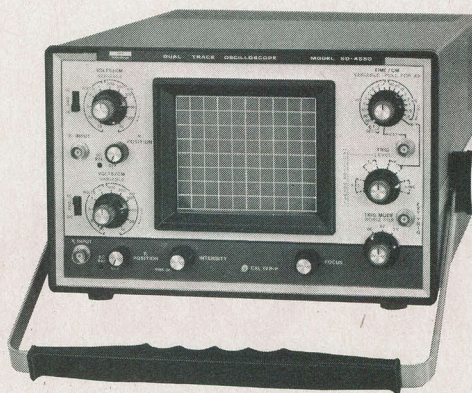
SG-5218 185.00
(\$2.85 shipping & handling)

Dual-trace DC-10 MHz Oscilloscope

\$650⁰⁰

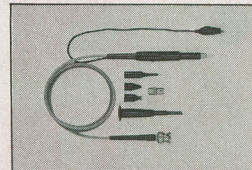
- Two vertical input channels with 10 mV/cm sensitivity
- 11-step attenuator for 10mV/cm to 20V/cm deflection factors
- 19-step horizontal time base from 0.2 sec/cm to 0.2 usec/cm
- Vertical accuracy within 3%
- X5 horizontal expansion
- Calibrated 1V peak-to-peak square wave signal
- 35 ns vertical rise time
- Automatic triggering
- 120/240 VAC, switch-selectable
- 6.9" H x 12.9" W x 19.3" D

SO-4550 650.00
(\$5.50 shipping & handling)



Combination x1, x10 Scope Probe

\$29⁹⁵



- Switch-selectable x1 and x10 attenuation at probe tip
- Center (ground) switch position allows quick zero level check
- DC to 15 MHz (x1) and DC to 80 MHz (x10) bandwidths
- 4.0 nS (x10) rise time
- Insulating tip, BNC tip adapter, IC tip, insulated compensation capacitor adjustment tool, vinyl case

PKW-105 29.95
(\$1.60 shipping & handling)

Order TOLL-FREE:
800-253-0570

8:00 AM to 8:00 PM Eastern Time M-F. Sorry, toll-free service not available in Alaska, Hawaii or Michigan. Call 616-982-3411, 24 hours a day, seven days a week. TLX: 72-9421



Instruments

For information on other Heath/Zenith Instruments write:
Dept. 010-698, Benton Harbor, MI 49022
GX-383

To receive your order faster, charge it!
Use your Visa, MasterCard or Heath Revolving Charge.
Please have your card or account number handy when you call.

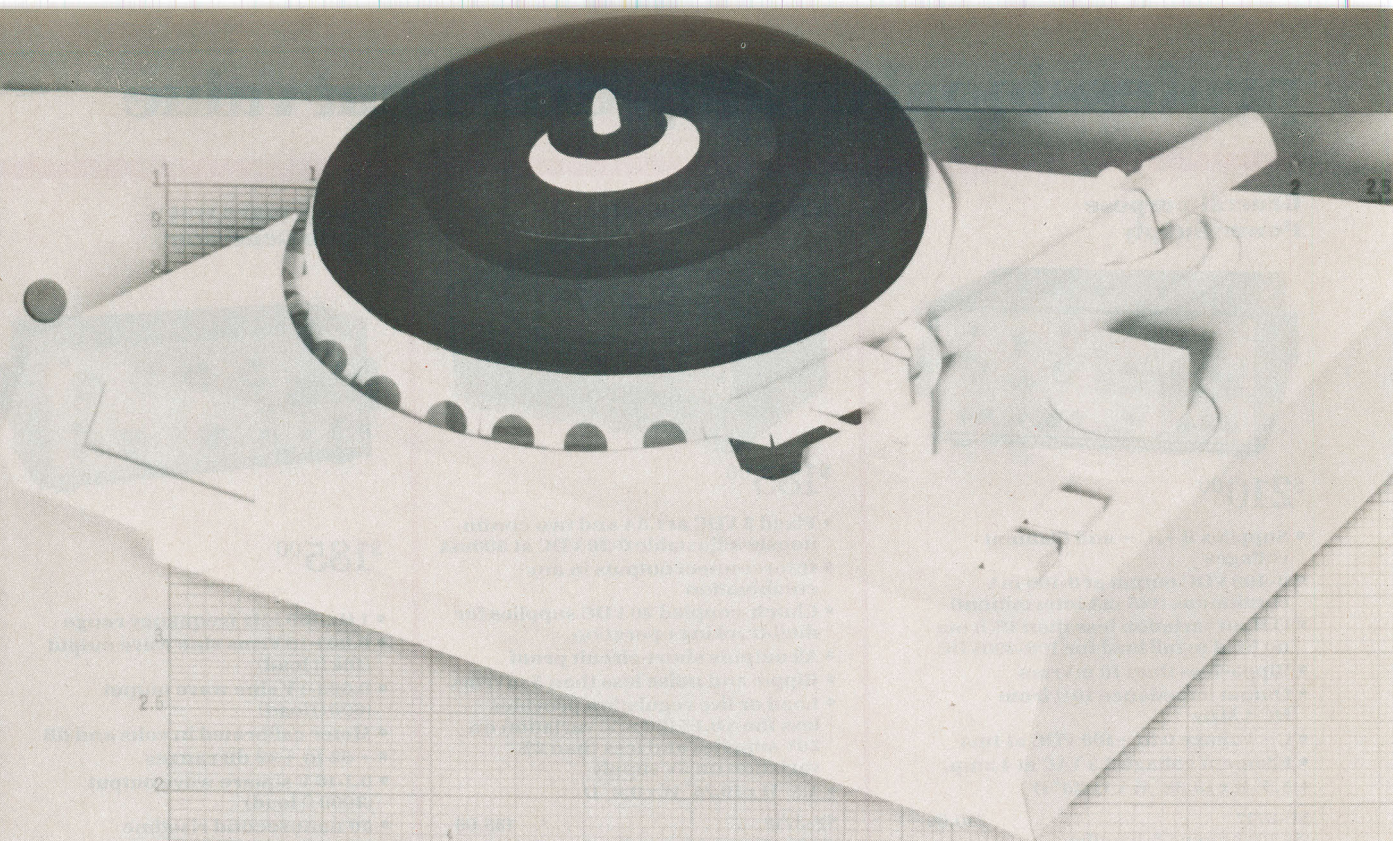


61 Service locations throughout the United States and Canada

Heathkit Electronic Centers in the U.S.* and Canada are listed in phone directory white pages.

*Units of Veritechnology Electronics Corporation.



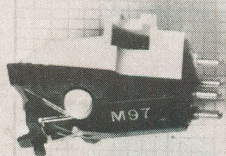


PE REVIEWS

Six Stereo Phono Cartridges

Results of listening and laboratory
tests on a sampling of units from
six different manufacturers

Shure Brothers



M97HE

Empire



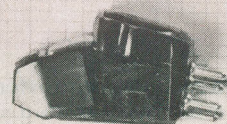
500ID

Audio-Technica



AT-30E

Sonus



Dimension 5

PHONO cartridges, like other electromechanical devices, are traditionally known as weak links in the audio playback reproduction chain. There is some justification for this, as advanced cutting techniques, such as operating at half speed, have made it possible to cut discs that playback systems cannot readily handle. Moreover, electronic amplifiers have progressed to the point where distortion is beyond the measuring capability of all but the most sophisticated test instruments.

The foregoing does not mean, however, that the erstwhile weak sisters have not gotten better. Indeed they have! Furthermore, we examined six phono cartridges ranging in suggested retail price from \$112 to \$250 and discovered that, though there are differences in measurements, we were hard pressed to *hear* truly significant aural changes between them except, perhaps, in the high end of the frequency range.

The Participants. The phono cartridges chosen for the test include late models from five of the largest manufacturers of this category of equipment—Shure Brothers, Audio Technica, Pickering, ADC, and Empire—and one from Sonus, a smaller manufacturer. Prices of the units range from \$112 to \$250, with the majority clustered around \$125. The Sonus Dimension 5, at \$250, represents a deluxe model, and the Audio-Technica AT-30E (\$125), being a low-output moving-coil type, will require a step-up transformer or head amplifier. (Audio-Technica's AT-630 step-up transformer is available for \$95.) Completing the line-up are the Shure M-97HE (\$112), the Pickering XSV-4000 (\$160), the ADC Integra XLM III (\$130), and the Empire 500ID (\$125).

Three of the cartridges have elliptical

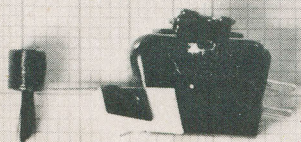
styli. The others—Shure's Hyperelliptical, Pickering's Stereohedrone, and the Sonus Lambda—have modified elliptical shapes that give an extended contact area with the groove wall and a very small tracing radius for improved high-frequency performance.

All of the cartridges tested track in the light to moderately light ranges of vertical force, as follows: ADC Integra XLM III, 1.2 ± 0.3 grams; Audio-Technica AT-30E, 1.4 to 2.0 grams; Empire 500 ID, 1.5 grams, $-0.25, +0.5$; Pickering XSV-4000, 1 gram ± 0.25 net (1 gram extra is used to compensate for the weight of the brush); Shure M-97HE, 0.75 to 1.5 grams (0.5 grams extra is added to compensate for its "dynamic stabilizer" brush); Sonus Dimension 5, 1 to 1.5 grams.

The Integra XLM III from ADC has an integral carbon-fiber headshell, the total mass of the combination being 12 grams. A special feature of the Integra headshell is that it incorporates adjustments for overhang and vertical tracking angle.

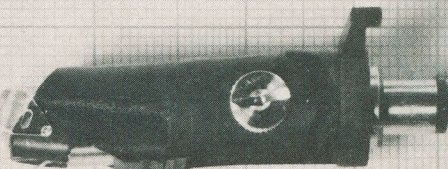
Laboratory Testing. Tests of frequency response and separation were run on the six cartridges, yielding the results shown in Figs. 1 through 6. Each cartridge was coupled to the load (a parallel combination of resistance and capacitance) indicated by the graph. As would be expected from a low-impedance pickup, even when working through a transformer, the Audio-Technica's frequency response was almost independent of its load. (Using a head amp would make the loading an entirely negligible factor.) Load capacitance is hardly significant for the Sonus and has but a slight effect on most of the others. The Empire, with a small peak at 10 kHz that is exaggerated by excess load

Pickering



XSV-4000

ADC



Integra XLM III

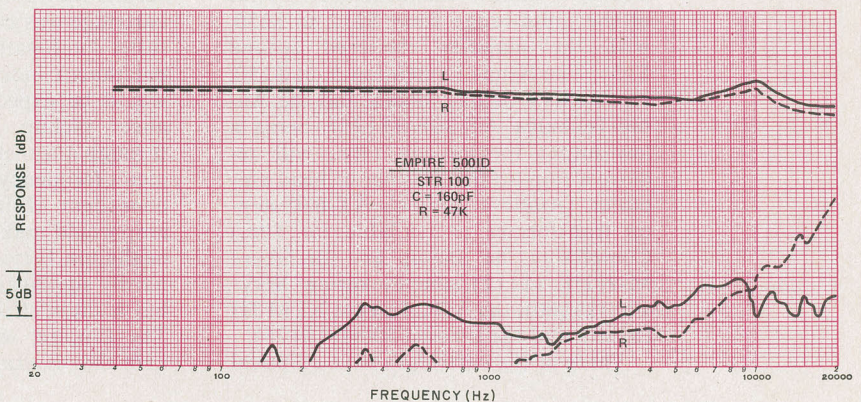
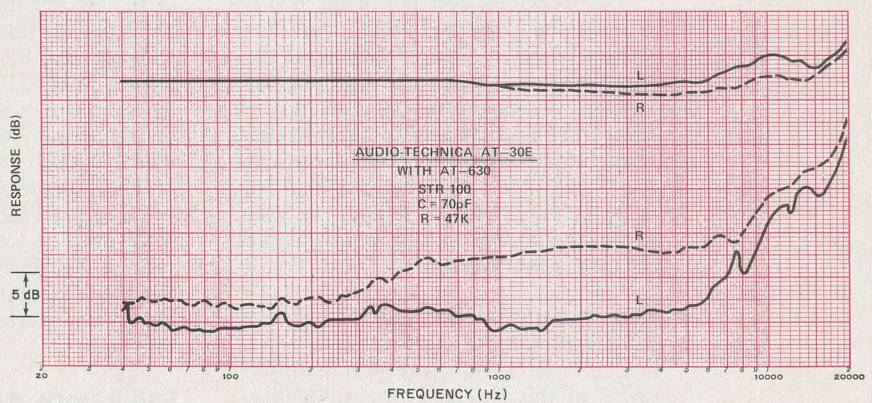
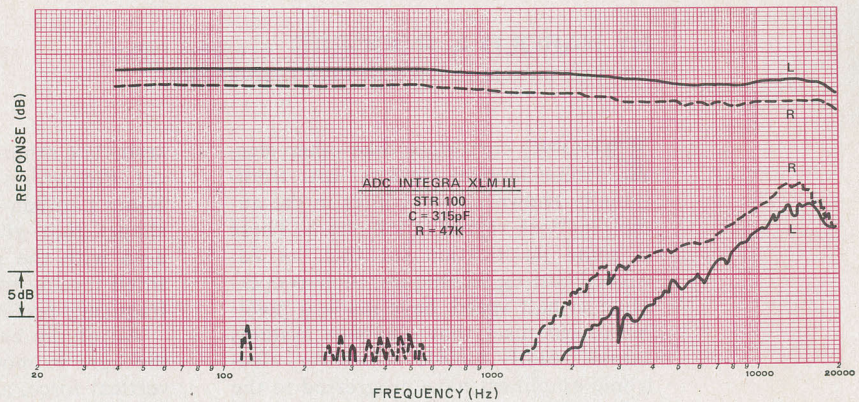
capacitance, is the most sensitive. This will hardly ever be a problem except in old turntables with high-capacitance wiring.

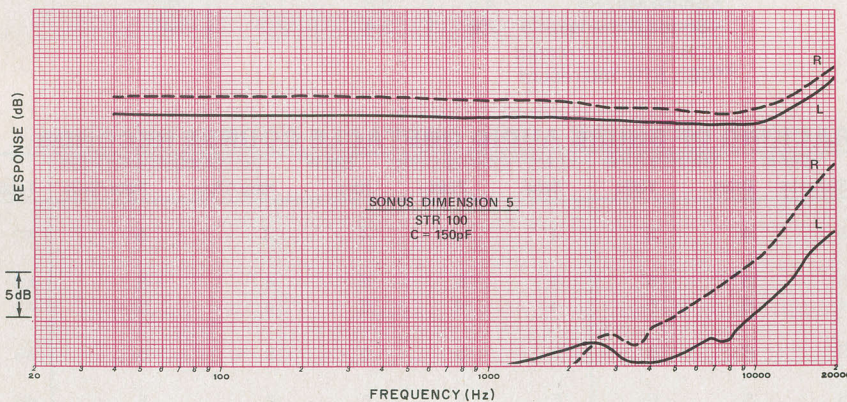
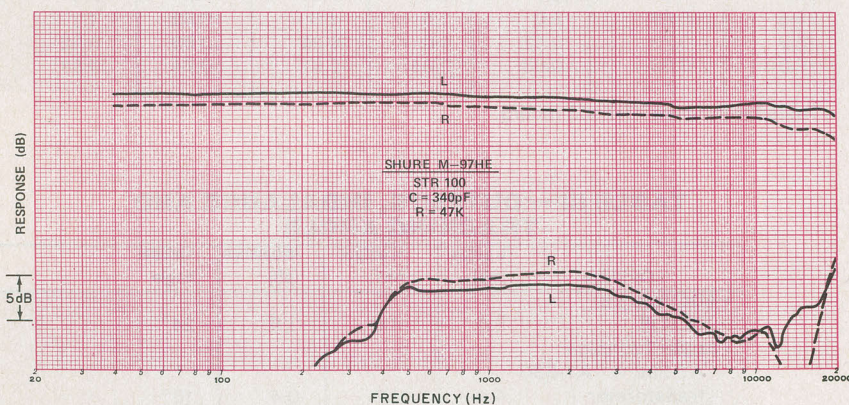
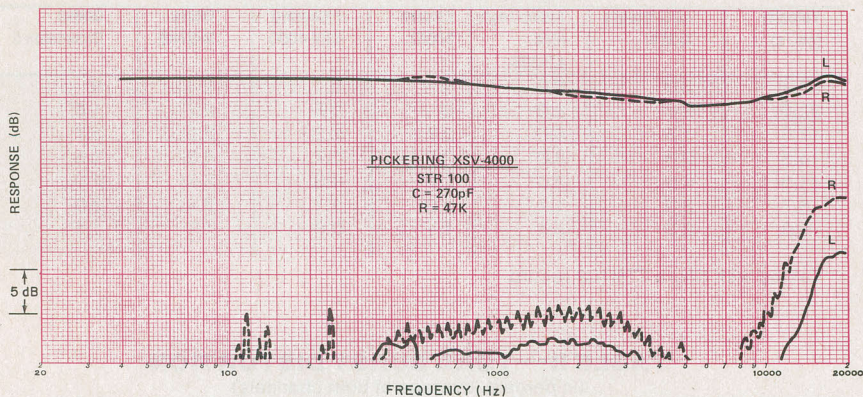
In general, the frequency-response curves are flat enough that their errors are of small concern. (As a matter of fact, since frequency-response results on cartridges have been shown to vary as a function of the test record chosen, the precise amounts by which these curves vary from perfection is a matter of doubt.) Crosstalk results also depend to a degree on how well the angle (nominally 90°) separating left and right modulation of the recording matches the corresponding angles in the cartridge. They are also sensitive to the angle (also nominally 90°) between the stylus and the disc surface when the cartridge is viewed from the front. Although there are differences in separation (freedom from crosstalk) between the units tested, in no case did we find it inadequate.

Distortion data, both for steady-state intermodulation and 10-kHz tone bursts is given in Tables I and II. Unfortunately, the correlation between distortion and listening quality is obscure in the case of phono cartridges. (The reasons why this is the case are complex and beyond the scope of this article.) Consequently, even though differences with respect to distortion were revealed by the testing, we cannot discuss the ways in which they might relate to performance. It seems noteworthy, however, that at their most linear, phono cartridges, like loudspeakers, produce levels of distortion that are gross compared with those generated by electronics.

Table III gives output voltages of the left and right channels of the cartridges, together with a figure in decibels that expresses the relative imbalance between the two. This measurement is made at 1 kHz. Since the frequency response typically varies by an amount comparable to the imbalance, it may not apply across the audio spectrum. Even the relatively large imbalance noted for the Sonus cartridge was not deemed serious, a conclusion that listening tests tend to support. Also, it's a simple task to adjust an amplifier's balance control to compensate for any imbalance.

The final column of Table III gives a measured value for vertical tracking angle. While the nominal standard for this parameter has been set at 20°, the measured data cluster fairly closely around an average of 23°. Though it has been shown that errors in vertical tracking angle can lead to excess distortion, the low correlation between distortion and listening quality would suggest that differences would be hard to hear. Our





Figs. 1 through 6. Plots of frequency response and crosstalk for the six cartridges tested. Note that the lower limit of measurement is 40 Hz.

listening tests tend to reinforce this view, uncovering no real differences that relate to vertical tracking angle.

Perhaps the most significant lab data from a practical point of view are those given in Table IV. The scores represent the highest-amplitude bands that could be tracked on the Shure "Era III and Era IV Audio Obstacle Course" discs. Some controversy has erupted around this test, partly on the ground that with monophonic modulation only in the test bands, the pickups are exercised in the lateral plane only, with the vertical plane neglected. Nevertheless, there appears to be a reasonably good correlation between a pickup's behavior in this test and how it works with "real-world" records.

As it turns out, data from this test is tightly clustered. A perfect score—which was achieved by two units—is 45, while the lowest score turned up was 40. Average score for the group was 42.8. Since the least capable cartridge in the test did about 89% as well as the best, tracking capability provides little in the way of a basis for choosing between them. Hirsch-Houck Laboratories, incidentally, defined mistracking in this test on the basis of audibility.

Listening Tests. Performing listening tests on six of anything puts the tester in an interesting bind. The same program material must, obviously, be used for all six components; otherwise there is no basis for comparison. On the other hand, as the listener becomes better acquainted with the program material through repetition, the psychological parameters of the test change willy-nilly. Is a certain "subtle clarity" heard in, say, the third unit tested a characteristic of the unit—or does the tester hear it that way because he now knows the music better?

To answer these questions, it would be necessary to repeat the test at least six times, rotating the order in which the units are tested and choosing a different selection of program material each time. This arrangement would perforce shorten the time spent listening during each trial, making it likely that factors that might be fatiguing in long-term listening will be missed. Also, because of the complex mechanical and electrical setup it would require, A-B testing also was not a viable alternative.

We finally settled on listening to each cartridge for a fairly extended period (three record sides) and noting any annoying characteristics that were heard. To be certain that these characteristics were presented as vividly as possible, listening was done through high-quality

phono cartridges

headphones, which we have found, through experience, to exaggerate minor faults.

In no case did we find that a pickup annoyed us noticeably. The six certainly do not all sound alike, but none of them is offensive. Interestingly, they seem to agree well for about 90% or so of what one hears; the differences are concentrated in the other 10% of reproduced sounds, lying, by and large, toward the upper end of the audio spectrum. All were capable of tracking the loudest passages of a Telarc digitally mastered disc without mistracking or obvious strain. We could have lived happily with any of the cartridges in the test. Were it not inappropriate in a test based on criteria as objective as possible, we might have chosen a personal favorite. We suspect, however, that even a choice as arbitrary as this might well vary from day to day.

The only oddities we observed were minor. Anti-skating force must be set quite carefully for the Pickering if the stylus is not to be dragged out of the groove by the brush. Also, the Shure brush (officially a "dynamic stabilizer") plays the grooves ahead of the stylus, creating a very faint pre-echo that can be heard when the stylus is in an unmodulated groove. We would not expect this to be problematic, for any modulation at all and even surface noises in some cases will mask the pre-echo. And if you are listening over speakers, the pre-echo will doubtlessly be swallowed up by ambient room noise. The dynamic stabilizer can be defeated, but then the aid it offers to tracking of warped discs will be lost.

TABLE I—INTERMODULATION DISTORTION
(in percent, average of both channels)

Velocity (cm/s)	ADC Integra XLM III	Audio-Technica AT-30E	Empire 500ID	Pickering XSV-4000	Shure M-97HE	Sonus Dimension 5
27.1	6.0	6.0	4	5	2.4	3
22.6	2.5	4.0	3	2.5	2.7	1.5
17.9	1.5	4.0	2.7	2.2	3.5	1.7
14.3	2.3	3.0	2.2	1.7	4.3	1.6
11.3	4.0	2.0	2.8	1.3	3.5	2.0
8.7	3.0	1.7	2.0	1.1	2.4	2.0
6.9	2.0	2.5	1.1	0.8	1.7	1.5

Tested with Shure TTR102 record

TABLE II—TONE BURST DISTORTION
(in percent, average of both channels)

Velocity (cm/s)	ADC Integra XLM III	Audio-Technica AT-30E	Empire 500ID	Pickering XSV-4000	Shure M-97HE	Sonus Dimension 5
30.	6.3	8.5	2.5	7.3	1.2	2.3
23.8	0.89	3.0	1.6	1.8	0.83	1.1
18.9	0.79	0.62	1.0	0.92	0.68	0.92
15.0	0.89	0.63	0.84	0.67	0.74	0.83

Tested with Shure TTR 103 record

TABLE III—OUTPUTS, IMBALANCE AND TRACKING ANGLE

Cartridge	L output (mV)	R output (mV)	Imbalance (dB)	Vertical Angle
• ADC Integra XLM III	5.5	4.6	1.5	24°
• Audio-Technica AT-30E w/ AT-630 transformer	4.4	4.2	0.4	18°
• Empire 500ID	4.2	4.0	0.4	22°
• Pickering XSV-4000	4.2	4.2	0	24°
• Shure M97HE	4.5	3.8	1.4	26°
• Sonus Dimension 5	2.6	3.4	2.3	24°

* CBS STR-100 record

**CBS STR-160 record

TABLE IV—CARTRIDGE TRACKING OF SHURE AUDIO OBSTACLE COURSE RECORDS

Cartridge	Vertical force	ERA III				ERA IV					Total
		Bells	Sibilance	Drum	Violin	Bells	Flute	Harp	Harp/Flute	Flute/Bells	
• ADC Integra XLM III	1.5	5	5	4	5	4	5	4	3	5	40
• Audio-Technica AT-30E	2	5	5	5	5	4	5	5	4	5	43
• Empire 500ID	1.5	5	4	5	5	4	4	5	4	5	41
• Pickering XSV-4000	1	5	5	5	5	5	5	5	5	5	45
• Shure M97HE	1.5	5	5	5	0	5	5	5	5	5	45
• Sonus Dimension 5	1.5	5	4	5	5	4	5	5	5	5	43

Numbers refer to maximum level on record that can be tracked without audible distortion.

In Conclusion. We can sympathize a little with the disgruntled reader who is about to ask: "Have you lead me through all this data and verbiage only to tell me that you can't find reason to prefer one of these cartridges over another?" But we would still answer: "Yes, that's the way it is, at least as far as what we can test is concerned." But that shouldn't bother you too much, for

you now know that you can't go too wrong. And we suspect that the price spread could be opened up a good deal more before any significant differences would be heard.

The price of a phono cartridge depends not necessarily on its performance, but on how costly it is to produce. It is almost as if one is dealing with art—if you like what you hear from a

certain model and that one pleases you above all others, then it is the one for you, and price is a secondary issue. And in some cases, you may not be able to narrow the choice *that* far. (That's why they make interchangeable headshells.) In any case, phono pickups seem to be getting better and better, and as they do, they will undoubtedly sound more and more alike. ◇

**don't be
penny-wise
and
sound
foolish**

fact: a Shure stylus is a sound investment

A new stylus (needle) can actually save you money. Even a precision crafted diamond stylus eventually wears out, and a worn or broken stylus tip can damage your records in a single play! Protect your records by checking your stylus at least once a year. Your Shure dealer can inspect it, and if necessary, replace your stylus with a Genuine Shure replacement stylus that will bring your cartridge right back to its original specifications.

**protect your
valuable
record
collection!**
**...and improve
your listening
pleasure**

**with a
GENUINE
SHURE
Replacement Stylus**

FREE! Shure Music-Lovers Stylus Guide

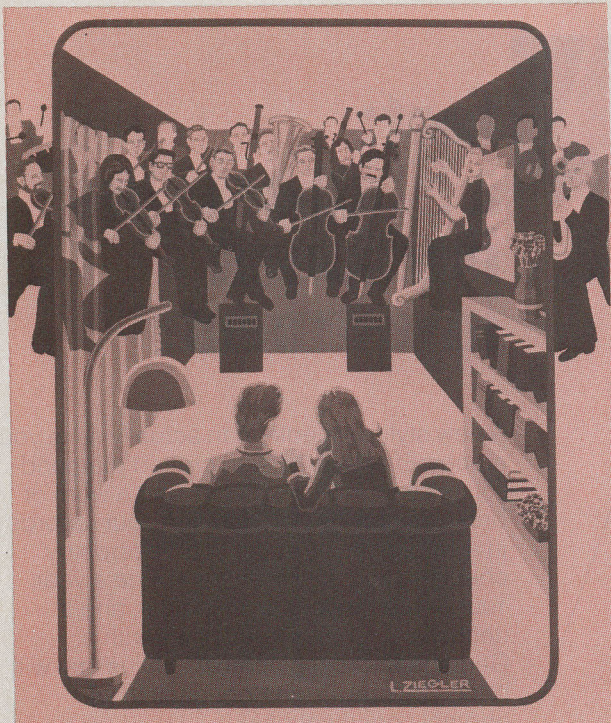
Cartridges don't wear out: styli do! This and many other helpful facts are discussed in a new pamphlet recently prepared by Shure. It includes everything you need to know to keep your Shure cartridge in perfect operating order. It even contains details on how you can improve the performance of some Shure cartridges beyond their original specifications. To get your copy, stop in at your Shure dealer, or write to Shure at the address listed below and ask for AL633.

**GENUINE
SHURE**

Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204

In Canada: A. C. Simmonds & Sons Limited Outside the U.S. or Canada, write to Shure Brothers Inc., Attn: Dept. J6 for information on your local Shure distributor.

Manufacturers of high fidelity components, microphones, sound systems and related circuitry.



Audio Time Delay Systems

CONCLUDED

Build a Digital Audio Delay Line

Computer-type RAM memory and both A/D and D/A converters are used in this second approach

BY JOHN NEVES, STEVE KOLUPAEV, AND DEBBIE DELAHANTY

IN the first two parts of this series, we described an audio delay system based on analog techniques using bucket-brigade devices as the principal active elements. This month we will concentrate on the use of digital techniques to achieve the same purpose.

The project described here uses A/D (analog-to-digital) and D/A (digital-to-analog) converters, random access memory (RAM), and a time base that provides the necessary synchronization for the digital system as well as determining the length of the delay.

Overall Operation. As shown in Fig. 1, the audio input is fed to a filter and amplifier combination that attenuates frequencies above 10 kHz (to prevent aliasing problems) and scales the signal level for the A/D converter.

An 8-bit A/D converter performs a companding conversion that increases the digital signal resolution to an equivalent 11 bits plus sign, giving a dynamic

range of approximately 70 dB. The converter operates under the control of synchronization pulses from the clock/controller. Digital information at the output of the A/D converter passes to a 4096 (4K in computer jargon) \times 8-bit RAM as a series of 8-bit "words." Timed by pulses from the clock/controller, the stream of digital words cycles through a desired number of memory locations, up to the maximum of 4096. At any point in the cycle, as an old sample is read from the data latch and passed to the D/A converter, a new sample is written into the memory.

The length of delay is determined by the number of memory locations through which each sample passes and the length of each sampling interval. (The number of locations traversed is set by the manual switches.) For example, if the sampling frequency is 25 kHz, one sampling interval is $1/25,000$ second or 40 microseconds. Therefore, if all 4096 memory locations are used, the total de-

lay will be $4096 \times 40 (\mu s)$ or 163.84 milliseconds. A 20-kHz rate would give a delay of 204.8 milliseconds.

Setting the memory address counter to some number between 1 and 4096 by means of the thumbwheel switches allows the delay to be varied while holding the sampling rate constant. Since the sampling rate also determines system bandwidth, changing the delay in this fashion does not affect frequency response. The fact that digital data is not degraded as it passes through the RAM means that the noise and distortion content of the output signal is also independent of the delay.

After the user-selected storage period, the digital data is read out of the memory and temporarily stored in a latch circuit that holds the digital data steady for the following D/A converter. Upon receipt of an appropriate timing pulse, the latch passes the digital data to the D/A converter where it is converted back into analog form. This analog sig-

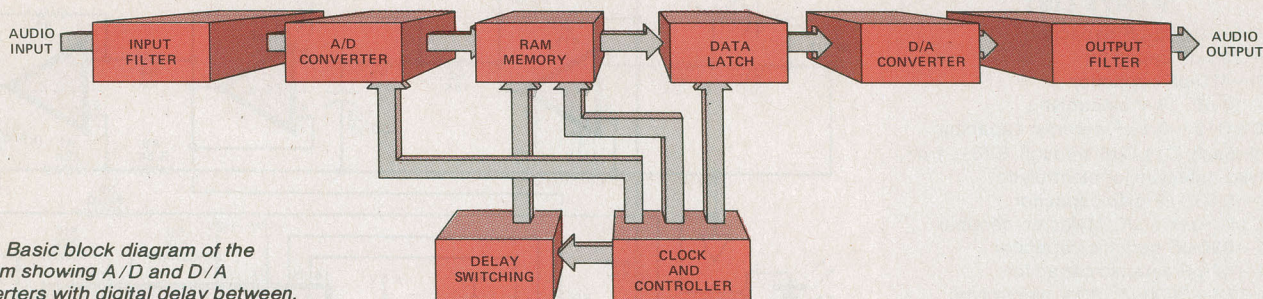


Fig. 1. Basic block diagram of the system showing A/D and D/A converters with digital delay between.

nal, now delayed, is filtered to remove any sampling components above 10 kHz that may be present. After filtering, the audio signal is amplified to bring it up to a level (about 1 volt) that can drive an audio amplifier.

Like the analog unit, the digital delay system is intended to be used with one or two auxiliary power amplifiers and loudspeakers. Ideally, there should be two delay units, one per channel. The signal should be delivered to your listening area at a level about 10 dB below that of the undelayed sound. For reasons detailed in Part 2, less expensive speakers and amplifiers can be used for the delayed sound channels.

To further economize, a single amplifier, speaker, and delay unit can be used. Audio from the two main channels can be resistively mixed and fed to a single delay unit as shown in Fig. 2.

The length of the delay produced by the unit can be adjusted in small increments to tailor it to the acoustics of your listening area. Start with about 20 milliseconds and experiment from there. Provision has been made to feed some of the output signal back to the input to generate reverberation. But if there is too much feedback, oscillation will occur.

Circuit Description. Due to its complexity, the circuit has been broken up into small, functional units. The individual circuits are interconnected by mating "letters-in-a-circle."

Input Filter and A/D Conversion. As shown in Fig. 3, IC1A and IC1B form a low-pass filter that amplifies all signals below 10 kHz. A comparator formed by IC1C monitors the amplified signal and turns on LED1 when the audio reaches the optimum four volts peak-to-peak.

The amplified signal from IC1B (pin 7) is passed to an A/D converter consisting of IC2A, IC18, IC22, IC24 and two of the gates in IC23. Timed by a "start conversion" pulse from the clock/controller, the incoming analog audio is converted into 8-bit binary code that is presented to the RAM for temporary storage. The converter performs a companding action, making the resolution of the digital signal equivalent to an 11-bit

word plus sign. Dynamic range is thus approximately 70 dB.

Memory and Latch. This circuit, shown in Fig. 4, uses eight conventional 4096 (bits) by 1 (bit) static RAMs (IC3 through IC10) arranged to form a 4096 (bits) \times 8 (bits) array. Static RAM is used to avoid the refresh cycles needed by dynamic RAM.

Each RAM element has its own unique address identified by the "An" (n stands for a digit) symbol above each RAM address line pin. Each RAM also has one pin (pin 8, R/W) that enables the RAM to accept data when the signal on this pin is in one logic state, and output the data when the pin is in the opposite logic state. Thus, under control of pulses from the clock/controller, the RAM can read in external data, or write out the data contained within its cells. The eight bits of data passed out of the RAM go to a pair of four-input data latches (IC11 and IC12) that hold the data in their internal flip-flops until a properly timed pulse from the clock/

controller causes it to pass to the D/A converter.

D/A Converter and Output Stages. The data from the RAM/latch circuit is applied to IC13, a D/A converter, as shown in Fig. 5. The reconstructed output signal from the D/A converter is almost identical to the filtered analog input, except that it is multiplied by a small scaling factor (due to amplification), contains a small amount of "quantization" noise caused by the D/A conversion, and, of course, is delayed.

After amplification in IC25A brings the signal up to about 1-volt peak-to-peak, the analog signal is passed through an active low-pass filter composed of IC25B and IC25C. The filter cuts off at 10 kHz, and attenuates any sampling frequency components that may remain in the signal. The output of IC25C is then used to drive the external audio amplifier.

Clock and Controller. The system clock, implemented by IC19 in Fig. 6, is the basic timing control for the system. Its main element is a vco (voltage-controlled oscillator) whose frequency is determined by the setting of R21. Varying the clock rate allows the user to experiment with effects such as vibrato, flanging, or frequency modulation. Keep in mind that the vco not only affects delay time but system bandwidth as well.

Counter IC17 accepts the clock signal and is configured to generate the four timed trigger pulses used by the A/D converter, RAM memory, and data latch. The four outputs are buffered by elements of IC20 and IC21 to convert the low-current CMOS outputs of IC17 into signals capable of driving TTL.

As shown in Fig. 6, the four timing pulses are identified as P1, P2, P3, and P4. Pulse P1 commands the start of an A/D conversion in IC18 (Fig. 3), while P2 increments (by 1) the memory address counter of Fig. 7. The resulting memory address points to the oldest stored sample. A new conversion will be completed eight clock pulses after P1.

The RAM is normally in the read mode, which means that the memory

(Figures 3 and 4 are on page 70.
Text continues on page 73.)

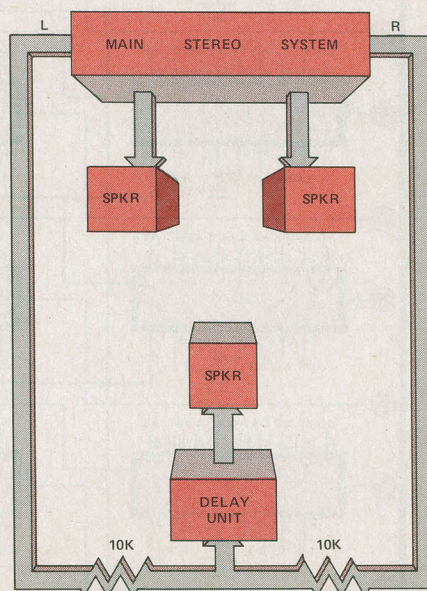


Fig. 2. Audio signals from the two main channels are mixed in resistors and applied to delay unit and a single speaker. Delay is adjusted to suit acoustics.

PARTS LIST

C1,C4,—0.005- μ F capacitor
 C2—220-pF capacitor
 C13—470-pF capacitor
 C5—10- μ F, 16-V electrolytic
 C6,C7,C19—0.1- μ F ceramic capacitor
 C8 through C11,C16 through C18—1- μ F, Mylar, tantalum, or electrolytic
 C12—0.033- μ F disc capacitor
 C3,C14—0.001- μ F, Mylar or ceramic
 C15—330-pF ceramic capacitor
 C20—47-pF ceramic capacitor
 C21,C22—5000- μ F, 20-V electrolytic
 D1—1N914 diode
 D2 through D5—1N4002 or similar diode
 IC1,IC25—LM324 quad op amp
 IC2—LM311N comparator
 IC3 through IC10—4K \times 1 static RAM, MM5257, TI4044, EMM4044, IM7141, MCM2141, 4104, 2613, HM4315, HM4847, or similar
 IC11, IC12—7475, 74LS75, four-bit latch
 IC13,IC22—DAC-76, DAC-88 companding D/A converter (Precision Monolithics or American MicroDevices)
 IC14,IC15,IC16—74193, 74LS193 up-down synchronous 4-bit counter
 IC17—4017 CMOS decade counter
 IC18—DM2502 successive approximation register (National or American MicroDevices)
 IC19—4046 CMOS phase-locked loop
 IC20—4010 CMOS-TTL buffer
 IC21—74LS00 quad two-input NAND gate
 IC23—7486, 74LS86 quad exclusive-OR
 IC24—7474, 74LS74 D flip-flop
 IC26—320T-12, negative 12-volt regulator
 IC27—340T-12, positive 12-volt regulator
 IC28—340T-5, positive 5-volt regulator
 J1,J2—Phono connector
 LED1—Light emitting diode

The following are 1/4-watt, 5% resistors unless otherwise noted:

R1—47 k Ω
 R2—18 k Ω
 R3—39 k Ω
 R4,R23,R28 through R39,R40,R41—10 k Ω
 R5—680 k Ω
 R6—3.3 k Ω
 R7,R10, R25—22 k Ω
 R8—820 Ω
 R9,R18,R20—4.7 k Ω
 R11,R24—51 k Ω
 R12,R13,R15,R16,R26,R27—2.7 k Ω
 R14—500 Ω potentiometer
 R17,R19—13 k Ω
 R21—10 k Ω potentiometer
 R22—2.2 k Ω
 R42—33 k Ω
 R43,R44,R45—100 k Ω potentiometer
 S1—Spst switch
 T1—24-V CT, 1-A (1.5-A for stereo)
 Misc.—Hex 2-digit thumbwheel switch (2) or 16-pin DIP switches, suitable enclosure (Mod-U-Box MBS 4-10-10 available from Intra Fab, 425 Queens Lane, San Jose, CA 95112 or similar), knobs, press-on type, mounting hardware, etc.

Note: The following are available from Videart, Box 10327, Stanford, CA 94305: etched and drilled pc board at \$18; DM2502 successive approximation register at \$6.80; DAC-88 converter at \$7.50; set of eight memory ICs at \$50. California residents please add 6.5% sales tax.

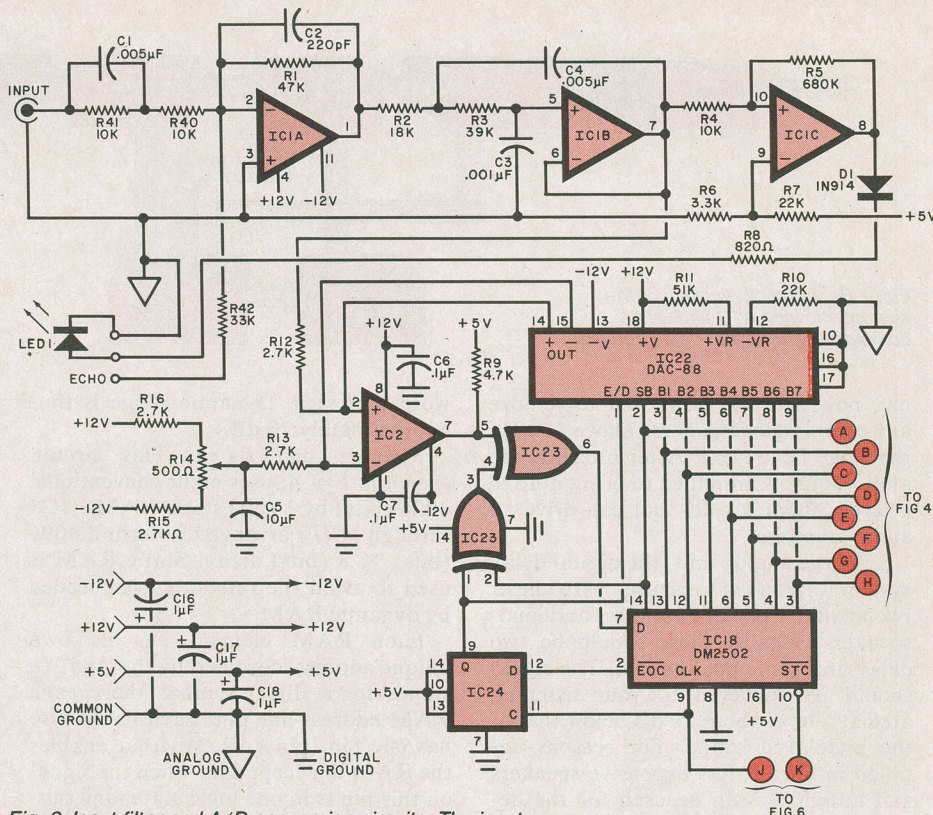


Fig. 3. Input filter and A/D conversion circuits. The input is filtered and amplified first and then converted to 8-bit binary code at the output to Fig. 4. A companding action makes the output equivalent to an 11-bit word plus sign.

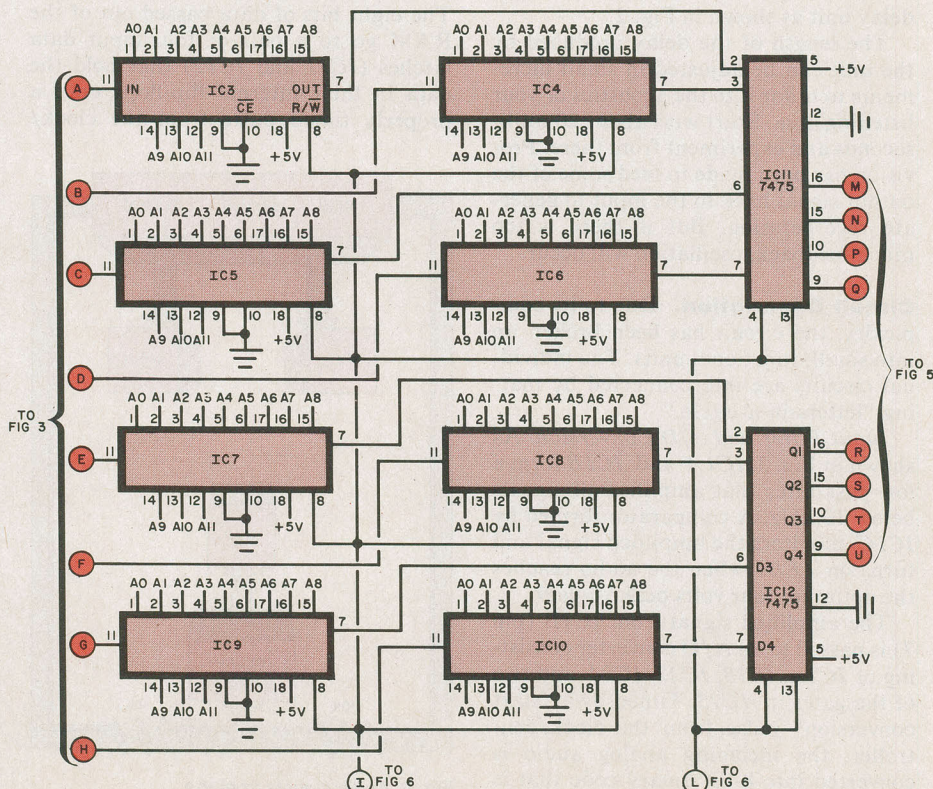
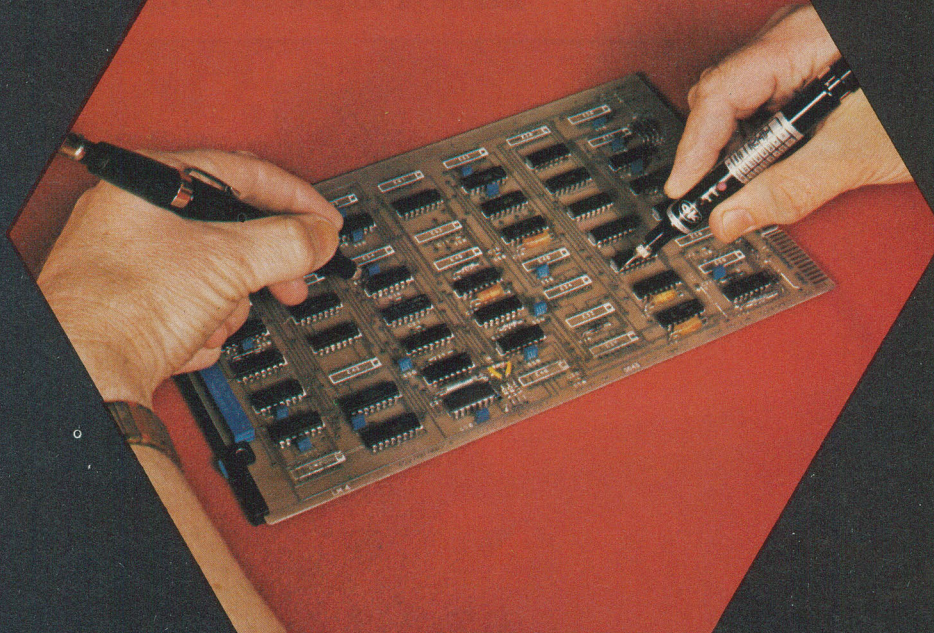


Fig. 4. Memory and latch circuits. Eight static RAM units (IC3 through IC10) are used to form a 4096 by 8 array. Each RAM can read in or write out data as determined by pulses from the clock/controller. Output is held in latches IC11 and IC12.



Digital IC Probe & Logic Pulser

PRB-1 DIGITAL LOGIC PROBE

Compatible with DTL, TTL CMOS, MOS and Microprocessors using a 4 to 15V power supply. Thresholds automatically programmed. Automatic resetting memory. No adjustment required. Visual indication of logic levels, using LED's to show high, low, bad level or open circuit logic and pulses. Highly sophisticated, shirt pocket portable (protective tip cap and removable coil cord).

- Automatic threshold resetting • DE to > 50 MHZ
- Compatible with all logic families 4-15 VDC • 10 Nsec. pulse response
- Supply O.V.P. to ± 70 VDC • 120 K Ω impedance
- No switches/no calibration • Automatic pulse stretching to 50 Msec.
- Open circuit detection • Automatic resetting memory
- Range extended to 15-25 VDC with optional PA-1 adapter

PLS-1 LOGIC PULSER

The PLS-1 logic pulser will superimpose a dynamic pulse train (20 pps) or a single pulse onto the circuit node under test. There is no need to unsolder pins or cut printed-circuit traces even when these nodes are being clamped by digital outputs.

PLS-1 is a multi-mode, high current pulse generator packaged in a hand-held shirt pocket portable instrument. It can source or sink sufficient current to force saturated output transistors in digital circuits into the opposite logic state. Signal injection is by means of a pushbutton switch near the probe tip. When the button is depressed, a single high-going or low-going pulse of 2μ sec wide is delivered to the circuit node under test. Pulse polarity is automatic: high nodes are pulsed low and low nodes are pulsed high. Holding the button down delivers a series of pulses of 20 pps to the circuit under test.

- High input impedance (off state) 1 meg ohm • Multi mode-single pulses or pulse trains
- Low output impedance (active state) 2 ohms • Automatic polarity sensing
- Output pulse width 2μ sec nominal • Automatic current limiting; 7 amps nominal
- Input over voltage protection +50 volts • Automatically programmed output level
- Finger tip push button actuated • Circuit powered
- Power lead reversal protection • No adjustments required
- Multi-family RTL, DTL, TTL, CMOS, MOS and Microprocessors.

PRB 1	DIGITAL LOGIC PROBE	\$36.95	PA 1	HIGH VOLTAGE ADAPTER	\$8.50
PC-1	POWER CORD, Alligator Clips	\$4.95	PT 2	REPLACEMENT PROBE TIP (2)	\$1.50
PC 2	POWER CORD, Micro Hooks	\$9.95	PLS 1	LOGIC PULSER	\$48.95

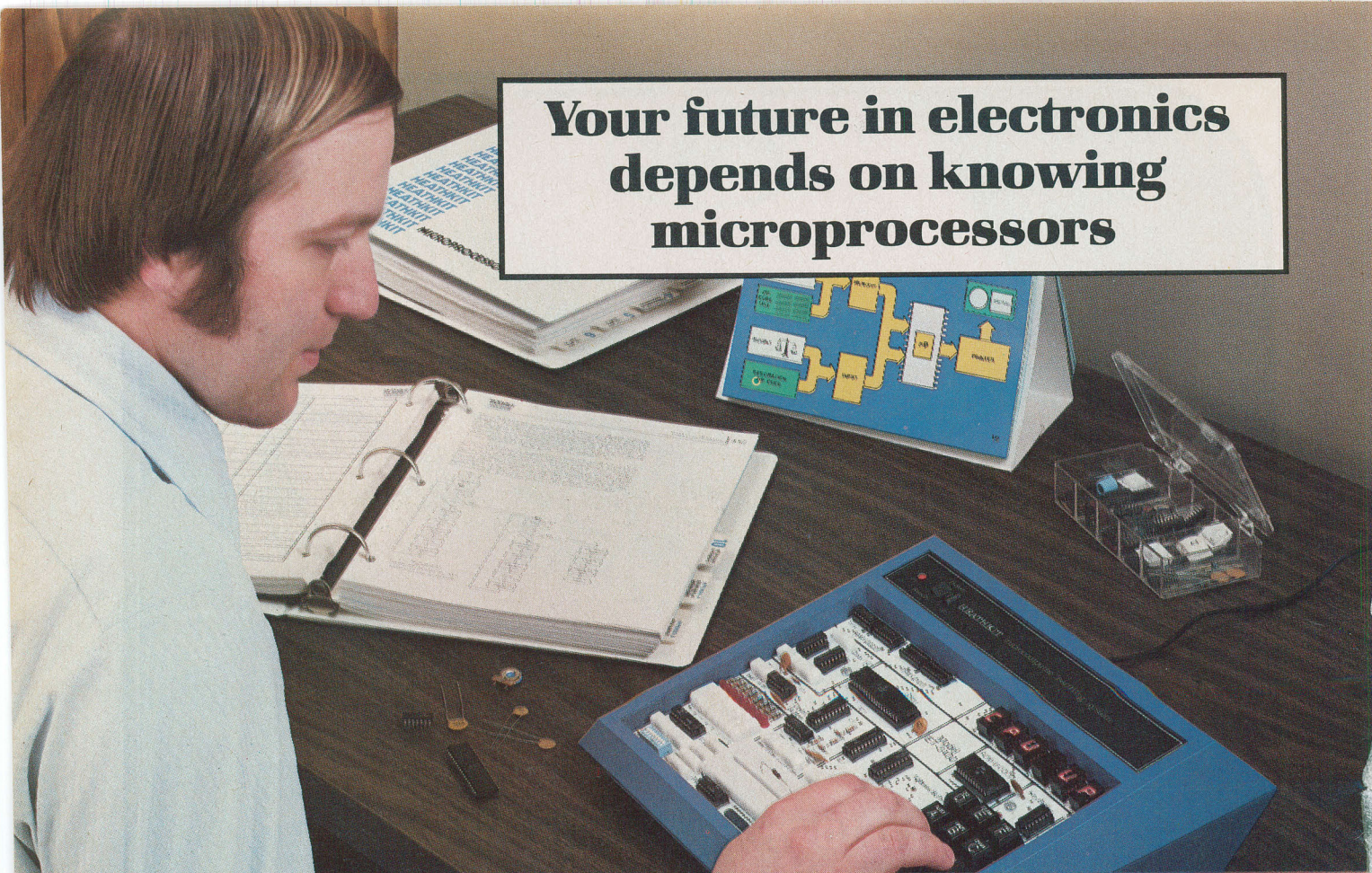
OK Machine & Tool Corporation

3455 Conner St., Bronx, N.Y. 10475 U.S.A.

Tel. (212) 994-6600 Telex 125091

* Minimum billings \$25.00, add shipping charge \$2.00
New York State residents add applicable tax

Your future in electronics depends on knowing microprocessors



To advance in the electronic-oriented world of today — and tomorrow — you need to understand microprocessors. Now, Heath/Zenith Educational Systems brings everything together in one complete, easy-to-follow self-instructional course on microprocessors — so you can gain the knowledge needed to secure your future in electronics.

Heath/Zenith's Microprocessor Course — as does every program in the Heath/Zenith Electronics Education line — reinforces each concept **FOUR** ways:

1. You **READ** clear, concise text material.
2. You **SEE** large, colorful visuals.
3. You **HEAR** audio cassette tapes which reinforce material presented in the text material and visuals.
4. You **PERFORM** programming and interfacing experiments, which give you hands-on experience in programming and interfacing microprocessors.

Sixty-two different electronic components are included, to make the Heath/Zenith Course an even better value. These parts are used in the hands-on programming and interfacing experiments.

The Heath/Zenith Microprocessor Course is backed by a Microprocessor Trainer, used to perform the experiments. Based on the popular 6800 microprocessor, this Trainer functions as a miniature digital computer. Built-in 1K ROM monitor program controls operation. Six-digit LED display provides address, data readout.

In the experiments, you work with actual components — to gain hands-on experience and confidence, and to make learning more effective.

Here is what you will know when you finish this easy-to-learn course:

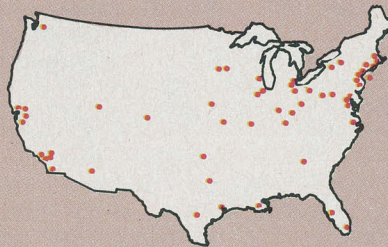
Programming — including branching, algorithms and flow-charting.

The 6800 Microprocessor — including architecture, instruction set, addressing modes and interrupts.

Interfacing — with ROM, RAM, displays and switches, D/A and A/D converters; using the Peripheral Interface Adapter (PIA).
Number Systems and Codes, Microcomputer Basics and Computer Arithmetic.

Turn to pages 74 and 75 of the latest Heathkit Catalog for full details on the Microprocessor Course and Trainer — and our complete line of top-quality Heath/Zenith Courses.

If you don't already have a Heathkit Catalog, send for your free copy at one of the addresses below. Or pick up your copy at the nearest Heathkit Electronic Center* in the U.S. and Canada, where Heath/Zenith Educational Courses are displayed and sold.



Start on the road to your future in electronics with the award-winning Heath/Zenith Microprocessor Course.

Don't wait until tomorrow for knowledge you can learn today.



Educational Systems

Dept. 010-693, Benton Harbor, MI 49022

In Canada: contact Heath/Zenith Educational Systems, 1480 Dundas St. E., Mississauga, Ontario L4X 2R7

Also at Heathkit Electronic Centers from coast-to-coast.

(*See the white pages of your phone book for the location nearest you. In the U.S., Heathkit Electronic Centers are units of Veritechnology Electronics Corporation.)

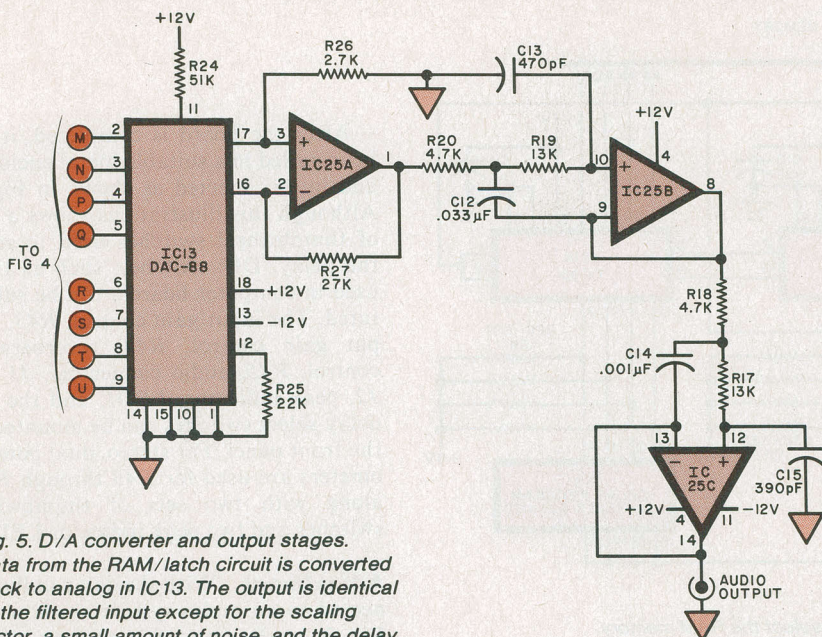


Fig. 5. D/A converter and output stages. Data from the RAM/latch circuit is converted back to analog in IC13. The output is identical to the filtered input except for the scaling factor, a small amount of noise, and the delay.

constantly displays the 8-bit code stored at the address pointed to by the memory address counter at its output. The third pulse, P3, is applied to the data latches (Fig. 4), causing them to load the result of the read operation and hold it stable for D/A conversion by IC13 (Fig. 5), which takes place in less than one microsecond. The last pulse, P4, causes a memory write operation that overwrites the old sample with the 8-bit code currently available at the A/D converter output.

Delay Switching. The delay switching uses three ICs to select the RAM memory addresses dialed in via the user-accessible switches as shown in Fig. 7.

Programmable counters IC14, IC15, and IC16 are cascaded with the clock input presented to IC16. Its "carry" output drives IC15, which in turn drives IC14. These counters can be preset to any desired modulo output by entering the control data on the input pins—in this case, voltage or ground from the user-selectable switches connected to S2 and S3. Thus, the outputs of each IC will agree with the manually preset count, independent of the clock frequency. Since there are 12 address lines, the count can reach a maximum of $2^{11} + 2^{10} + 2^9 + \dots + 2^0 = 2^{12} - 1 = 4095$ and the delayed bits can pass through any desired number of memory locations.

Power Supply. The power supply, shown in Fig. 8, uses a full-wave rectifier in conjunction with -12, +12, and +5-volt regulators. The system draws 450 mA at +5 volts, and about 20 mA from each of the 12-volt supplies.

The 5-volt power requirement can be reduced by using "LS" or "C" versions of IC11, IC12, IC14, IC15 and IC16. Do not use "L" devices because these usually have different pinouts. Regulators IC27 and IC28 should be supplied with heat sinks.

Construction. Given the complexity of the circuit, construction is best implemented by using either Wire-Wrap Techniques or a printed circuit board. In the former case, care should be exercised concerning the ground connections. As shown in the schematics, the analog digital grounds should be isolated from each other and merge only at the power supply common point.

Due to their size, etching and drilling guides and component layout for a double-sided pc board for the project are not reproduced here, but can be obtained by sending a self-addressed 9-by-12 envelope with two units of first-class postage to Dept. DDL, Editorial, POPULAR ELECTRONICS, One Park Ave., New York, NY 10016.

Outputs of the address counters (IC14, IC15, and IC16) should be kept as short as possible and as far away as possible from the input and output op amps. The use of IC sockets is recommended, and the proper installation of polarized elements must be observed.

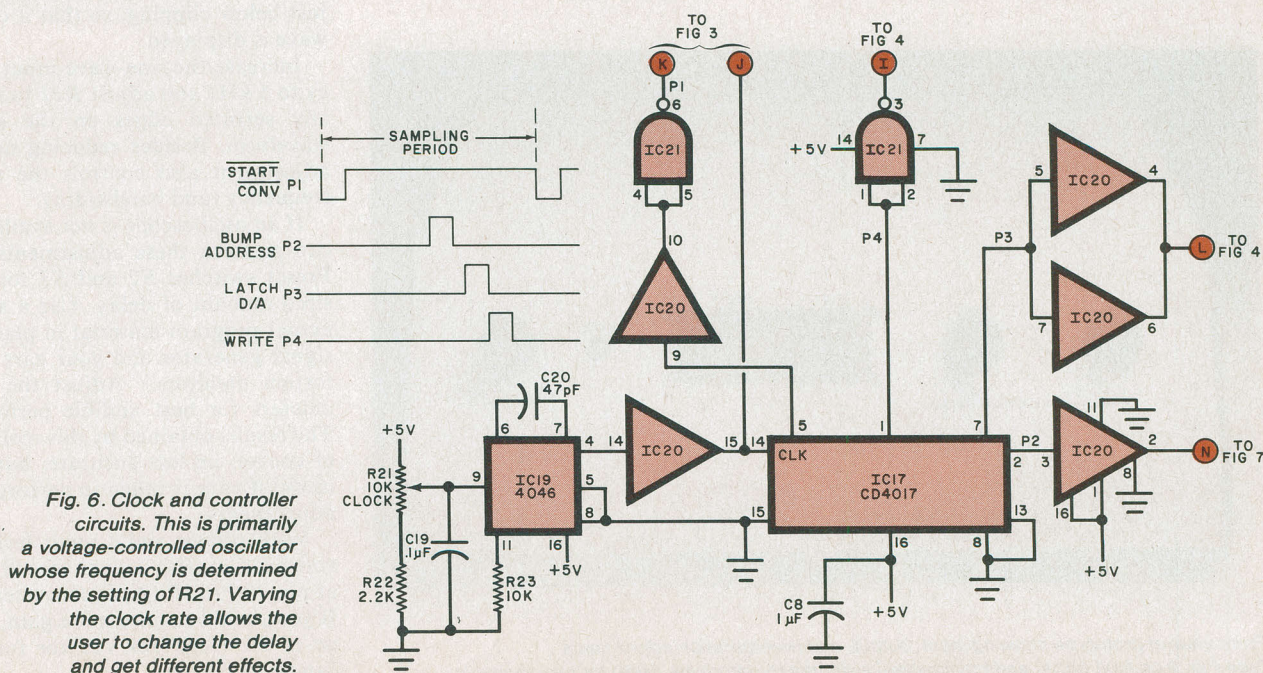


Fig. 6. Clock and controller circuits. This is primarily a voltage-controlled oscillator whose frequency is determined by the setting of R21. Varying the clock rate allows the user to change the delay and get different effects.

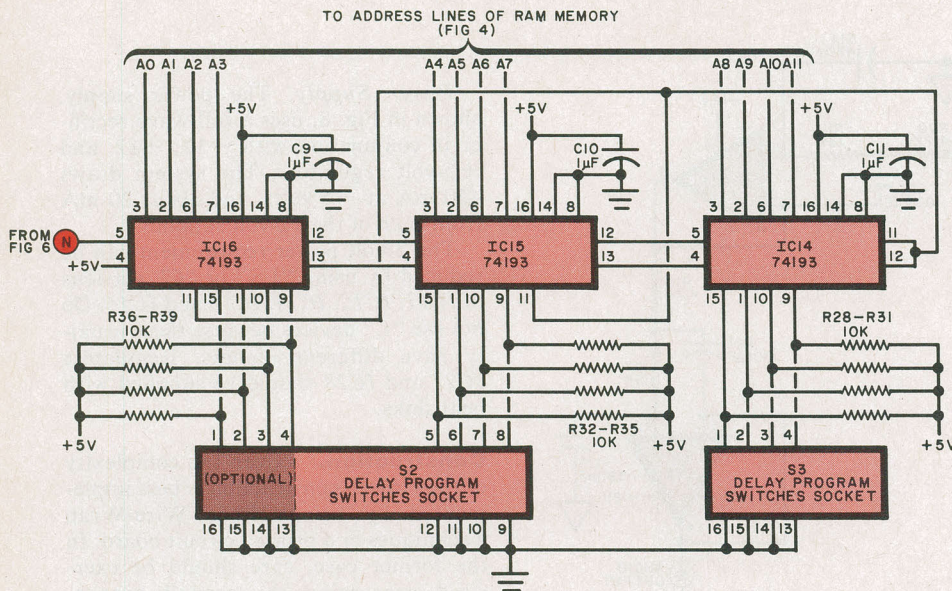


Fig. 7. Delay switching circuits. Three ICs are used to select the RAM memory addresses dialed in by the program switches S2 and S3.

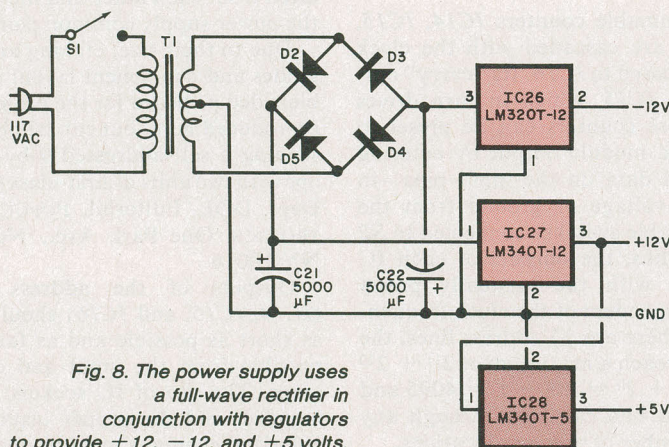


Fig. 8. The power supply uses a full-wave rectifier in conjunction with regulators to provide +12, -12, and +5 volts.

After the board is completed, it can be installed in a suitable metal enclosure and interconnected as shown in Fig. 9. Although this illustration shows a pair of thumbwheel switches used to select the delay, DIP switches, such as those used in computer boards, can be substituted. The input gain control, *R43*, output gain control, *R44*, reverberation control, *R45*, audio connectors, *J1* and *J2*, peak indicator, *LED1*, and the two delay-select switches can be mounted on the front panel. For stereo, dual potentiometers are used for *R43* through *R45*, along with two sets of thumbwheel switches and two peak indicator LEDs.

Adjustment. With the delay unit connected to an audio system as shown in Fig. 2, set *R14* and *R21* to their center positions. Place the delay switches (*S2* and *S3*) in the minimum configuration (all switches open). Then adjust echo (reverb) potentiometer *R45* for its minimum resistance, and the audio input control (*R43*) to its center rotation position.

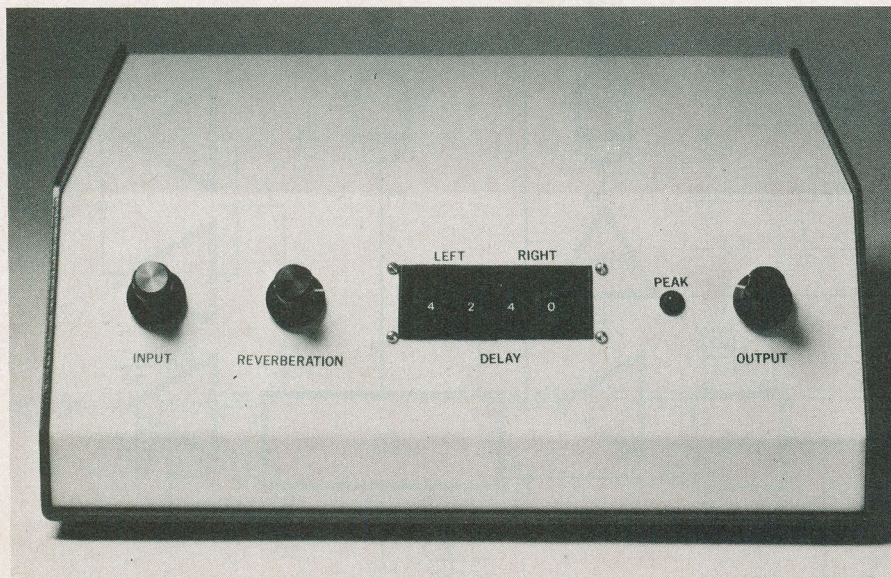
Apply a 1-kHz sine-wave signal to the audio input (*J1*), and an oscilloscope to the *J2* audio output connector. With power turned on, adjust output control *R44* for a convenient scope display.

Increase the audio input level, either by adjusting *R43* or the audio signal generator's level control, until some clipping is noted on the output waveform. Successively adjust the input level and *R14* to obtain a symmetrically clipped sine wave. Then reduce the input level to just below clipping, so that a clean sine wave is displayed.

Increase the sine-wave input frequency to 5 kHz and adjust *R21* to minimize any serrated edges on the displayed waveform. Besides reducing noise, this adjustment also controls the sampling frequency (and bandwidth).

If an oscilloscope is not available, you can perform these adjustments by ear. Preset switches *S2* and *S3* for the desired amount of delay. Use a source of actual program material in place of the signal generator and your ears as "distortion monitors." Adjust the potentiometers for best audible performance. The results obtained by this method will, of course, be less accurate, but will be useful if care is taken in performing the adjustments.

With proper audio input levels, a 4-volt peak-to-peak signal should be seen at pin 7 of *IC1B* (A/D converter input). If you should require more gain, the value of *R1* (feedback resistor for *IC1A*) can be increased.



Front view of prototype showing input, output, and reverberation adjustments (see Fig. 9 on next page) and thumbwheel switches to determine delay for two channels.

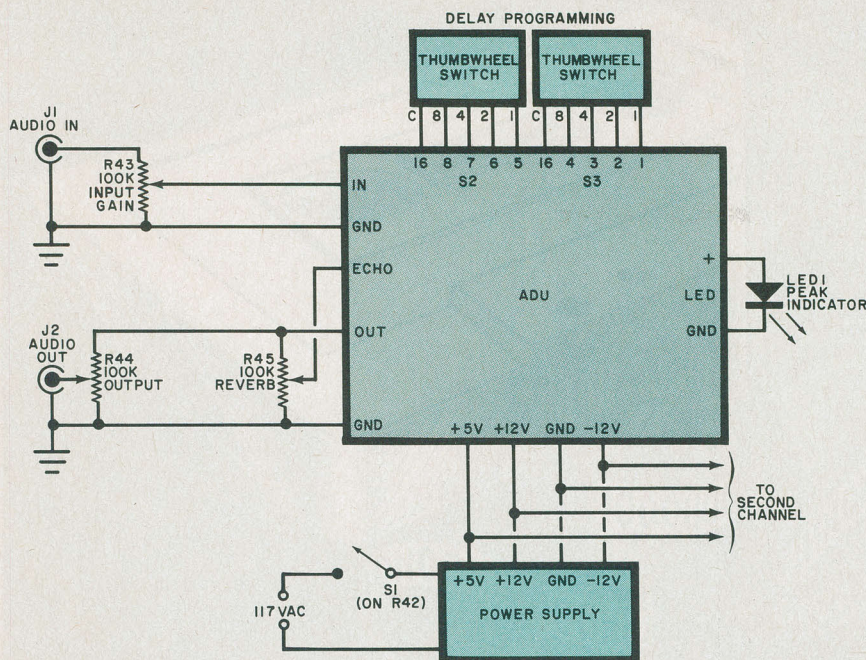
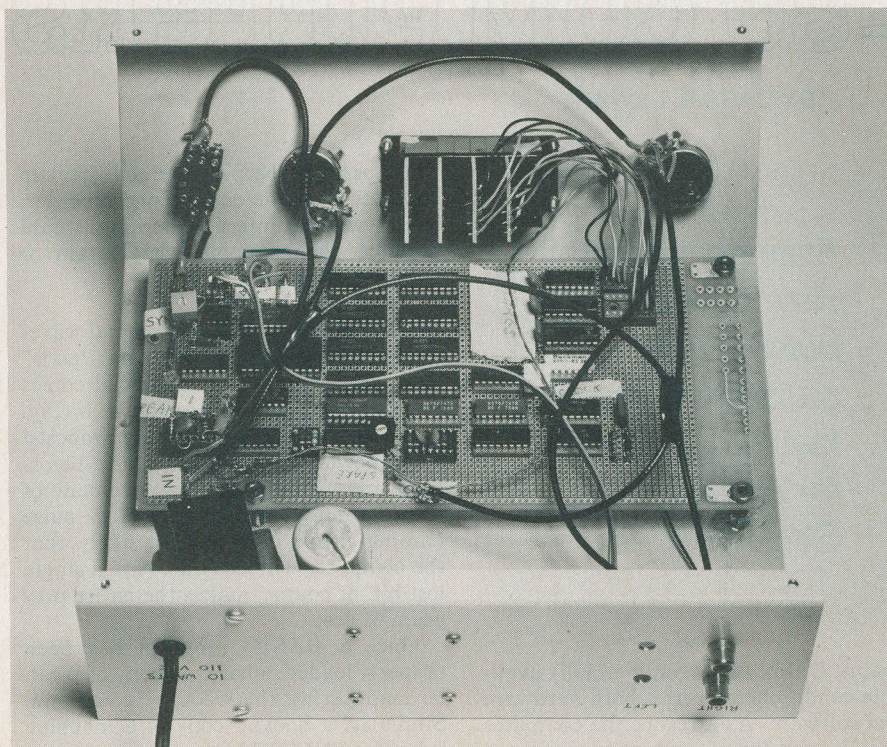


Fig. 9. Schematic of components that are not mounted on the printed circuit board. See photos below and on previous page for ways in which to locate the components.

The memory address counter (IC14, IC15, IC16) can be checked by setting S2 and S3 for maximum delay. This causes each of these IC's to count down by 16. An oscilloscope or frequency counter can then be connected to the A0 through A11 outputs of these ICs to note the decreasing frequencies.

A scope can also be used to follow the

audio signal through to the A/D converter. The digital outputs of IC18 vary with the applied audio signal. If a dc voltage level from zero to about 1 volt is applied to the input, the bit changes can be observed as the input voltage level is changed. Zero volts will produce all zeroes and 1 volt will create all ones, with 254 binary states between the two. ♦



Internal view of prototype shows arrangement of board and components on front panel.

SEPTEMBER 1980

THIN SOLAR

12/24-Hour Quartz Alarm Chronograph

Now with fashionably thin styling, long-lasting solar power, 12- or 24-hour selection, alarm and full chronograph.

Featuring:

- Famous Quartz Accuracy to ± 5 Seconds a Month
- Built-in Electronic Calendar
- Night Light for Evening Viewing
- Constant LCD Display
- Day of the Week Indicator
- Easily Adjusted "Snap" Type Bracelet

Thinnest Solar Alarm Chronograph Available at This Low Price!

\$44.88

Solar Power is now combined with remarkably thin styling and famous quartz accuracy in our best selling 12/24-Hour Alarm Chronograph. A combination that Seiko and Citizen can't match, even at \$200 more!

See the value you get for only \$44.88

- **24-Hour Alarm** — Pleasant, but effective, alarm can be preset for any minute of day or night. Constantly read indicator lets you know when it's set.
- **12/24-Hour Selection** — You get conventional 12-hour time or 24-hour military time at the touch of buttons. Switch back and forth as often as you choose. Or, leave it on 12- or 24-hour time for as long as you want. A must for pilots, military personnel or anyone who needs the option of 12 or 24 hour time.
- **Powerful Solar Recharger** — Fully recharges itself even in artificial light. Power that's guaranteed for three full years with life expectancy of many more. No more troublesome battery charges!
- **Full 12-Hour Chronograph** — With 1/10 second precision, add time and lap time. Add time lets you time everything from a telephone call to a trip ... up to 12 full hours. Lap time lets you time each component within an event. Ideal for production managers, coaches, sports fans, anyone with a critical time dependent activity.



- **Continuously Shows:**
- Hours, Minutes and Seconds
- Day of Week Flag
- AM/PM Notation in 12-Hour Mode

- **Quartz Accuracy** — to ± 5 seconds a month.

- **Month, Day and Date** — at the push of a button.



Shown: September 18 Tuesday

COMPARE THINNESS!

Thinnest Solar Alarm Chronograph available at this low price.

Seiko	\$250	10.5 mm
Citizen	\$255	11.0 mm
Texas Instruments	\$125	12.0 mm
Thin Solar	\$44.88	9.5 mm

- **Handsome Styling** — Crafted, quality stainless steel back and bracelet. Optional goldtone model now available with 3 micron quality gold plating at \$49.88.

- **15-Day No-Risk Trial** — Try it for 15 days, if you're not completely satisfied with its quality and features, return it to us for a prompt refund of your purchase price. In addition, there's a full One-Year Manufacturer's Warranty against defective parts and workmanship.

Easy To Order. Just call our toll free number below, or fill in the convenient order form. Order yours today!

MEDIA MARKETING, INC.

10155-9 Plano Road, Dallas, TX 75238

- ☐ Yes! Please send me _____ Thin Solar 12/24-Hour Quartz Alarm Chronograph(s), with 15-Day No-Risk Return Privilege, at \$44.88 each, plus \$2.50 postage and handling. Texas residents add 5% sales tax.
- ☐ Silvertone ☐ Goldtone \$49.88

Name _____

Address _____

City _____

State _____ Zip _____

☐ Check or money order enclosed

For even faster service, charge to:

☐ Master Charge/Visa Expires _____

Account # _____

Signature _____

ORDER TOLL FREE 1-800-527-7066

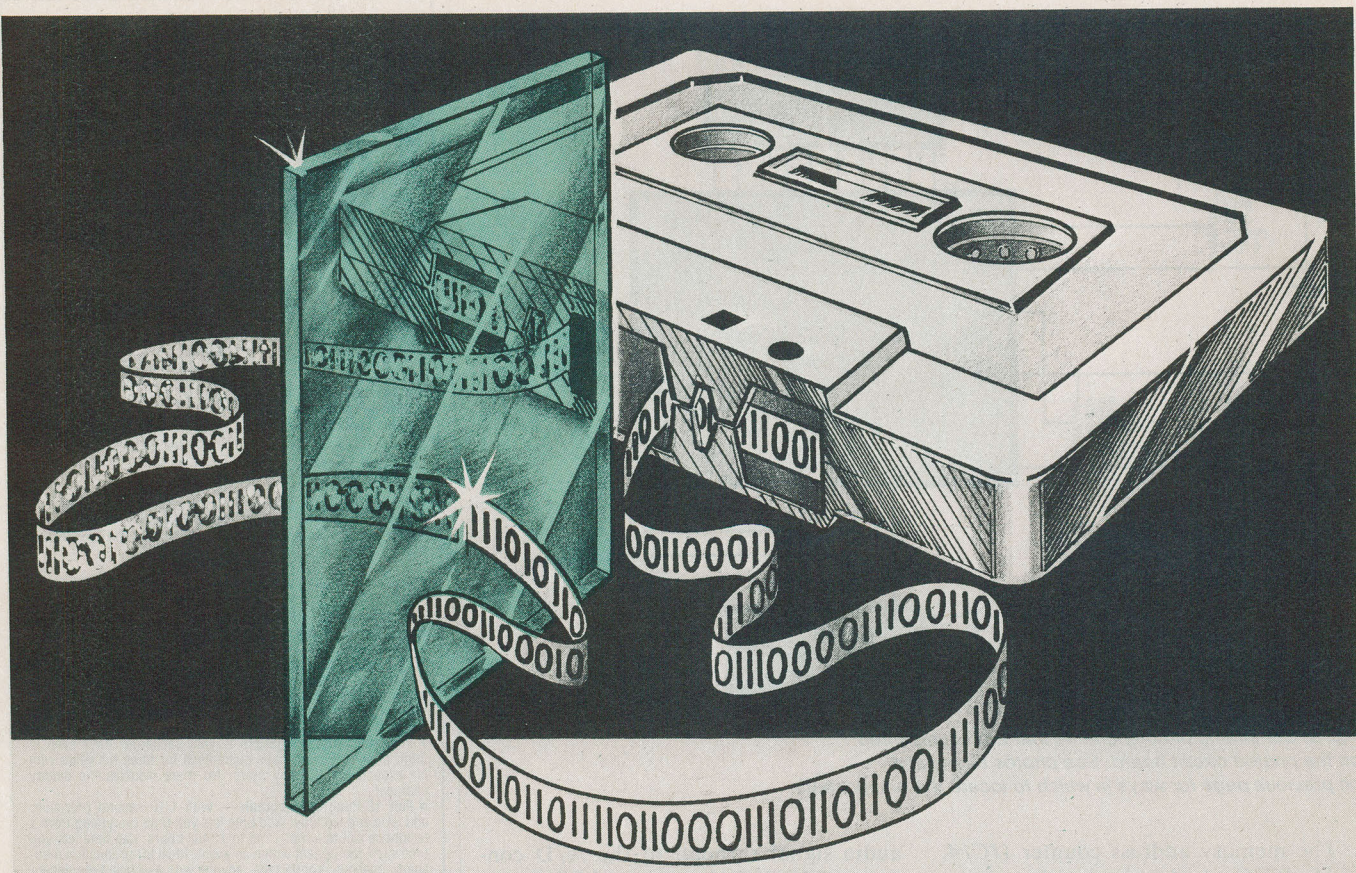
In Texas Call 1-214-349-3120

©MMI - 1980

P E - 7

CIRCLE NO. 44 ON FREE INFORMATION CARD

75



HARDWARE-SOFTWARE TAPE CONDITIONER FOR TRS-80 COMPUTERS

BY CASS R. LEWART

WHEN difficulties occur in loading data from a cassette tape into a microcomputer, it is usually because the commercial tapes being used are poorly duplicated. This is further compounded by the quality of the tape itself and even the inadequacies of home tape machines. In the case of the popular TRS-80, a narrow tape level setting range and fussy timing requirements exacerbate the problem. Though the "Peak-Reading Meter" in the February 1980 issue of POPULAR ELECTRONICS enables one to set the proper level quickly, it does not correct for poorly shaped pulses or timing jitter, both of which are major obstacles to successful loads. The Tape Regenerator project described here has been designed for this purpose.

The Regenerator is an advanced breed of tape-conditioning device. It is for use with TRS-80 Level II BASIC and machine language (SYSTEM) pro-

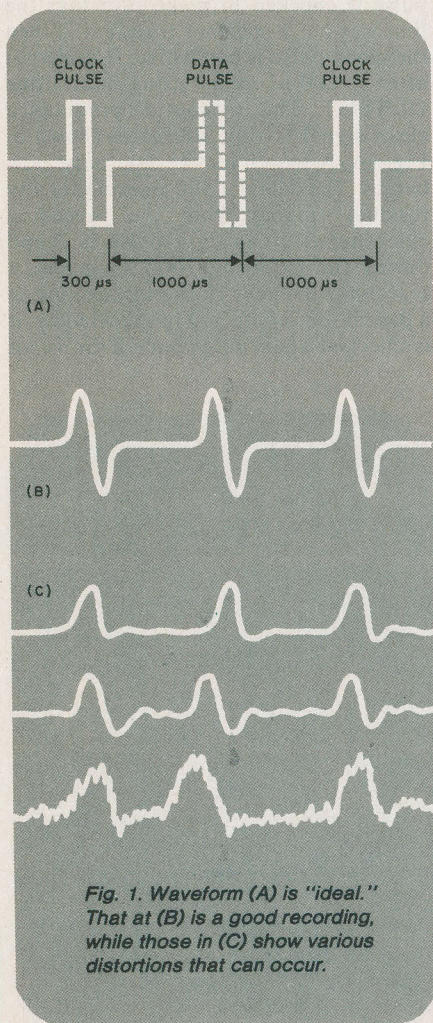
*Reshaping and
retiming data
pulses ends
cassette-tape
loading problems
for BASIC and
SYSTEM data*

grams. Unlike other commercially available conditioners, it uses both hardware and software. As a result, the computer itself is used for curing timing problems.

This permits properly timed backup copies to be made on a second recorder, which, without internal retiming, would produce backup copies that retain or worsen timing jitter.

How It Works. The ideal signal waveform and typical "good" and "poor" waveforms found on commercial copies of Level II programs are shown in Fig. 1. As shown in Fig. 1C, superimposed noise, power-line hum, amplitude distortion, and ringing and displacement of the data pulse relative to the clock pulse (timing jitter) can make it likely that the computer will lose bits. And a single lost bit, of course, makes the entire program useless.

Once a BASIC program has been properly loaded, a back-up copy of it can be made using the CSAVE command. Similarly, a backup copy of a machine language (SYSTEM) program can be



made with a monitor program, e.g. Radio Shack T-BUG. However, the original program must be readable and short enough to fit into memory without overwriting a monitor program.

The Tape Regenerator and the associated program, DUB3 (see Table), overcome these limitations by reshaping and retiming the pulses to produce new tape that the TRS-80 can easily read.

Multiple-segment programs (some programs feature a separate loader) or several programs on a single tape pose no problems for the Regenerator either. Operating on one pair of clock/data pulses at a time without storing the whole program in RAM as monitor programs do, the Regenerator allows even a TRS-80 computer with only 4K of RAM to make back-up copies of arbitrarily large programs and handle tapes containing multiple programs in a single cassette pass.

To test soundness of the Tape Regenerator design, the author created five generations of the same program and found that the fifth-generation tape would load as easily as the original.

Circuit Description. The circuit shown in Fig. 2 reshapes the clock and data pulses received from the tape recorder and feeds them to the computer. Audio transformer *T1* provides dc isolation between the tape recorder and the Regenerator circuit. Switch *S1* and diodes *D1* and *D2* allow selection of the "better" half of the pulse (see Control Adjustments later on), while zener diode *D3* and transistor *Q1* further shape the incoming signal. One OR gate in *IC1* decodes the IN command from the computer (via the *P1* connector) indicating that the computer is ready to accept data. When the command occurs, *IC1* (pin 8) then activates *IC2* (via pin 15) to allow the amplified tape recorder signals

to pass via the connector *P1* and the expansion port to the computer data bus. Indicator *LED2* and optional meter *M1* indicate that the tape recorder is sending data at the proper level, and *LED3* glows when regenerating program DUB3 is up and running. If no back-up copies are required, *J2* provides a "quick and dirty" direct output to the TRS-80 via the tape-recorder plug. The signal at this point is not retimed and is only partially reshaped. This limited processing may make a tape readable.

Power for the circuit (Fig. 3), is provided by transformer *T2* in conjunction with voltage regulator *IC3*, bridge circuit *RECT1*, and capacitors *C1* and *C2*. Power on is indicated by *LED1*.

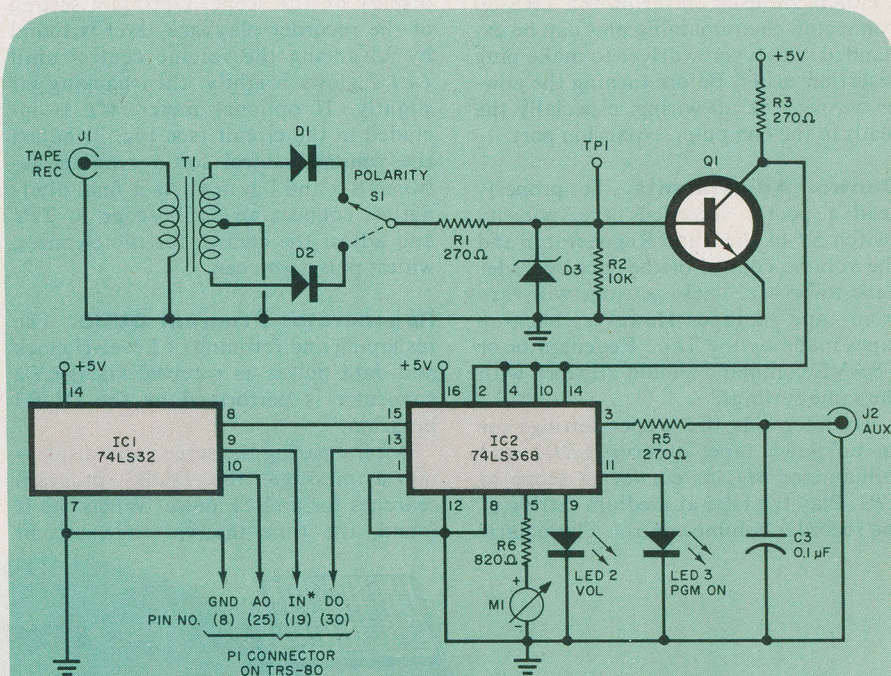


Fig. 2. The Tape Regenerator is controlled by signals from the TRS-80 that are determined by the DUB3 program. A second recorder is connected to the auxiliary output at jack J2.

PARTS LIST

C1—200- μ F, 35-V electrolytic
C2,C3—0.1- μ F disc capacitor
D1,D2—1N914 silicon diode
D3—3.9-V zener diode
IC1—74LS32 quad OR gate
IC2—74LS368 hex tri-state buffer
IC3—7805 +5-volt regulator
J1,J2—Miniature phone jack
LED1,LED2,LED3—Red light-emitting diode
M1—1-mA meter (Radio Shack 270-1752 or similar)
P1—2 \times 20 edge connector on 0.1" centers to fit expansion port on TRS-80 keyboard or expansion interface
Q1—Npn Darlington Transistor (HEPS9100 or similar)
R1,R3,R5—270- Ω , 1/2-W resistor

R2—10-k Ω , 1/2-W resistor
R4,R6—820- Ω , 1/2-W resistor (optional)
RECT1—50-V, 1-A bridge rectifier
S1,S2—Spdt switch
T1—Audio transformer (Radio Shack 273-1380 or similar)
T2—12-volt transformer (Radio Shack 273-1385 or similar)
Misc.—Suitable enclosure, 2 DIP sockets (14 pin and 16 pin) line cord, solder, etc.
Note—The following is available from Southwest Technical Products, 219 W. Rhapsody, San Antonio, TX 78216, Dept. TR-1: complete kit of parts including a pc board and listing of DUB3 program in BASIC to allow POKEing into memory, but excluding M1, at \$29.95 postpaid. Texas residents, add 4% sales tax.

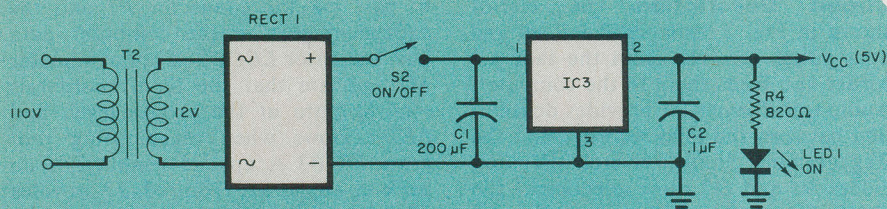


Fig. 3. The power supply is a simple rectifier-regulator circuit as shown here.

Construction. The circuit can be assembled on a small pc board, or Wire-Wrap techniques can be used. Keep all leads as short as possible. As only four contacts are used on the 40-pin TRS-80 connector, the remaining pins can be expanded with a screwdriver to make plug insertion easier. Before turning the power on, recheck all wiring, especially the leads to the computer expansion port.

Control Adjustments. To properly read a poorly recorded tape, polarity switch *S1* of the Tape Regenerator and the volume control of the tape recorder have to be set. These settings will vary from tape to tape. However, back-up tapes made by the Tape Regenerator or CSAVE command should all work with the same settings.

To determine the proper settings for an unknown tape, observe *LED2* and milliammeter *M1*, or connect a scope to *TP1*. Play the tape at medium setting of the recorder volume control. Flip polari-

ty switch *S1* and leave it in the position corresponding to a stronger signal as evidenced by a brighter LED, higher reading on the meter, or a cleaner pulse display on the scope. Optimum setting of the recorder playback level is found by advancing the volume control until *LED2* glows brightly, then backing off slightly. If optional meter *M1* is included in the circuit (see Fig. 2) adjust the volume control for a reading between 0.5 and 0.6 mA. As a final alternative, connect an oscilloscope to *TP1* and adjust the control for the cleanest, widest pulses you can.

Regenerator Program DUB3. The reshaping and retiming of Level-II clock and data pulses as received via the *P1* connector is performed by the DUB3 program.

After clearing the screen and displaying a message, the DUB3 program searches for a clock pulse. When one is found, the time interval to a second

pulse is checked to make sure that the first was not a spurious transient. When the clock pulse is confirmed, it is output after a 200-μs delay using subroutine OUTPUT. This subroutine produces a clean signal lasting 300 μs as shown in Fig. 1A. A search for the data pulse now begins. The delay of 500 μs excludes any residual ringing from the preceding clock pulse. If no data pulse is found during the following 700-μs window, a search for the next clock pulse begins. If a data pulse is detected in the window, it is checked again to exclude a transient

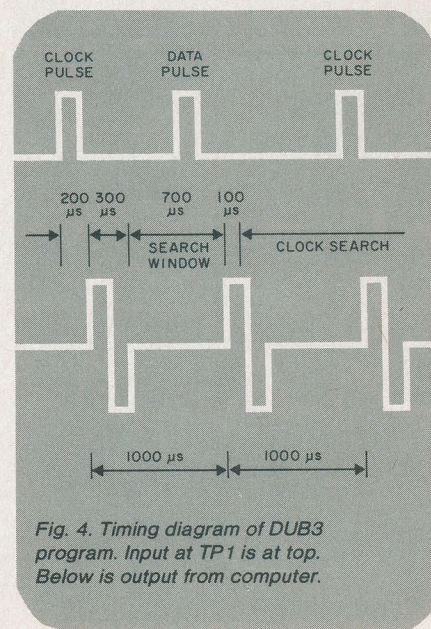
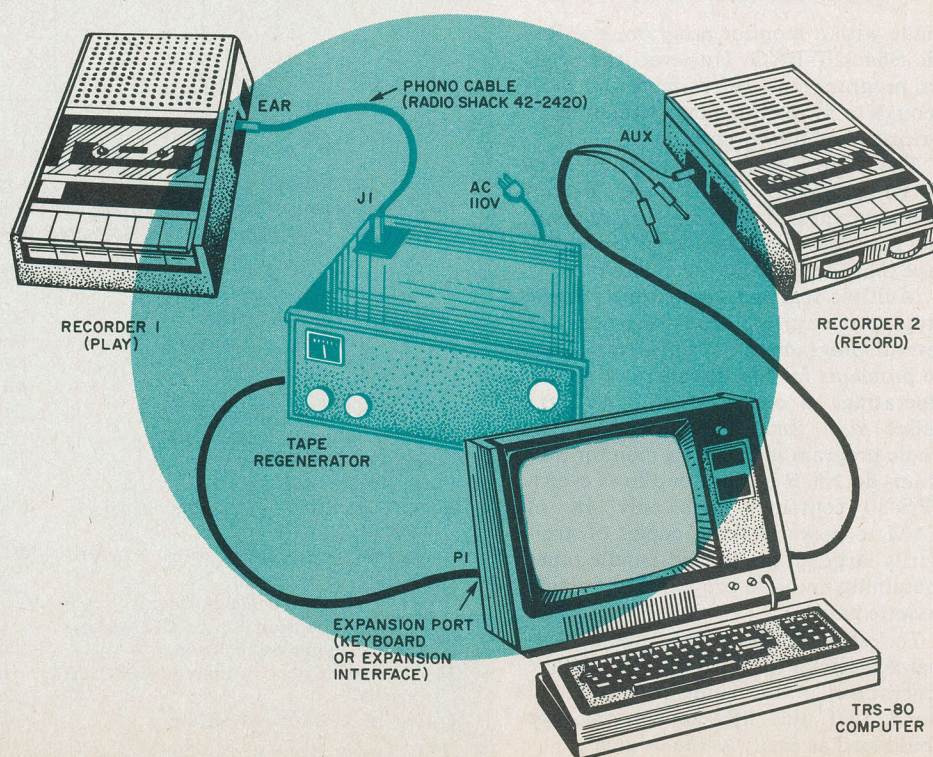


Fig. 4. Timing diagram of DUB3 program. Input at *TP1* is at top. Below is output from computer.

Fig. 5. Electrical interconnection of the Tape Regenerator to the TRS-80 computer and two tape recorders.



TABLE—LISTING OF DUB3 PROGRAM

00100	PORT	EQU	00H	
00110	CENTER	EQU	04H	
00120	HIGH	EQU	05H	
00130	LOW	EQU	06H	
00140	DL100	EQU	0CH	
00150	DL150	EQU	12H	
00160	LEN1	EQU	14H	
00170	DL200	EQU	1AH	
00180	DL700	EQU	22H	
00190	LEN2	EQU	22H	
00200	CASS	EQU	0FFH	
00210	CLS	EQU	01C9H	
00220	LINE1	EQU	3DD6H	
00230	LINE2	EQU	3E0FH	
00240		ORG	4A00H	
00250	DUB3	CALL	CLS	;CLEAR SCREEN
00260		LD	HL,TAB1	;DISPLAY LINE 1
00270		LD	DE,LINE1	
00280		LD	BC,LEN1	
00290		LDIR		
00300		LD	HL,TAB2	;DISPLAY LINE 2
00310		LD	DE,LINE2	
00320		LD	BC,LEN2	
00330		LDIR		
00340	START	LD	B,DL100	;100 MICS DELAY
00350	DELO	DJNZ	DELO	
00360	SRCHC	IN	A,(PORT)	;START CLOCK PULSE SEARCH
00370		RRA		
00380		JR	NC,SRCHC	;CLOCK PULSE FOUND?
00390		IN	A,(PORT)	;YES, TRANSIENT ONLY?
00400		RRA		
00410		JR	NC,SRCHC	;YES, KEEP SEARCHING
00420		LD	B,DL200	;NO, SET 200 MICS DELAY
00430	DEL1	DJNZ	DEL1	
00440		CALL	OUTPUT	;PUT OUT CLOCK PULSE
00450		LD	B,DL700	;START 700 MICS READ WINDOW
00460	SRCHD	IN	A,(PORT)	;SEARCH FOR DATA PULSE
00470		RRA		
00480		JR	C,FOUND1	;FOUND?
00490		DJNZ	SRCHD	;NO, WINDOW TIMED OUT?
00500		JR	START	;YES, SEARCH FOR CLOCK PULSE
00510	FOUND1	IN	A,(PORT)	;TRANSIENT ONLY?
00520		RRA		
00530		JR	C,FOUND2	;NO
00540		DJNZ	SRCHD	;YES, WINDOW TIMED OUT?
00550		JR	START	;YES SEARCH FOR CLOCK PULSE
00560				;DATA PULSE FOUND,
00570	FOUND2	INC	IX	;WASTE 10 CYCLES
00580		BIT	3,(HL)	;WASTE 12 CYCLES
00590		DJNZ	FOUND2	;WINDOW TIMED OUT?
00600		CALL	OUTPUT	;YES, PUT OUT DATA PULSE
00610		JR	START	;SEARCH FOR CLOCK PULSE
00620	OUTPUT	LD	A,HIGH	;PULSE OUTPUT
00630		OUT	(CASS),A	;PULSE HIGH
00640		LD	B,DL150	;150 MICS DELAY
00650	DEL2	DJNZ	DEL2	
00660		LD	A,LOW	
00670		OUT	(CASS),A	;PULSE LOW
00680		LD	B,DL150	;150 MICS DELAY
00690	DEL3	DJNZ	DEL3	
00700		LD	A,CENTER	
00710		OUT	(CASS),A	;RESTORE TO CENTER
00720		RET		
00730	TAB1	DEFM	'TAPE BACK-UP PROGRAM'	
00740	TAB2	DEFM	'COPYRIGHT (C) 1980 CASS R. LEWART'	
00750		END	DUB3	

and, if confirmed, is output at the end of the 1-ms interval that started at the beginning of the preceding clock pulse (Fig. 4).

A data pulse appearing any time between 500 μ s and 1.2 ms after a clock pulse is thus correctly retimed to occur exactly 1 ms after the clock pulse. After a 100- μ s delay, the program continues with the search for the next clock pulse. The DUB3 program can be loaded using the Radio Shack Editor/Assembler or by keying in the Z80 instructions. For a BASIC version of the DUB3 program which will POKE the instructions into memory see the Parts List.

Operating Instructions. The electrical interconnection between the Tape Regenerator, both tape recorders and the computer is shown in Fig. 5. Turn the computer and Tape Regenerator power off when plugging or unplugging the 40-pin connector at the rear of the TRS-80 keyboard.

If you have the Expansion Interface connected to your computer, use the Expansion Port on the left side of the Expansion Interface instead of the Expansion Port at the rear of the keyboard. When power is applied to computer and Tape Regenerator, LED1 should glow and the MEMORY SIZE? prompt should appear on the video monitor. If the prompt does not appear, check connections, in particular the 40-pin connector, between the Tape Regenerator and TRS-80. Load the DUB3 program and run it. Light LED3 (PGM ON) should glow as long as DUB3 is running. The program is in an infinite loop and will run until you depress the RESET push-button on the rear of the TRS-80, or turn the computer off.

For initial adjustment, start reading tape from tape recorder 1 and set polarity switch S1 and the Tape Recorder volume control as explained under "Control Adjustments."

Rewind tape recorder #1 and start it in the play mode while starting tape recorder #2 in the record mode with a clean tape. When the program on tape recorder #1 is finished, LED2 (VOL) will extinguish and meter M1 will indicate close to zero. This is the signal for you to turn both tape recorders off. You can continue with as many tapes as desired. When finished, open S2 to turn the Tape Regenerator power off, press the RESET button to return to BASIC, or turn the computer off. The 40-pin connector P1 can be left plugged permanently into the Expansion Port as it does not interfere with the normal computer operation. If the pulse amplitude on the original tape is very unsteady or the pulses are imbedded in noise, regenerating the tape may not be possible. ◇

EQUIPMENT AND TRAINING NO OTHER SCHOOL CAN MATCH.

**NTS HOME TRAINING INVITES YOU TO EXPLORE MICROCOMPUTERS,
DIGITAL SYSTEMS AND MORE, WITH STATE-OF-THE-ART EQUIPMENT
YOU ASSEMBLE AND KEEP.**

Without question, microcomputers are the state of the art in electronics. And NTS is the only home study school that enables you to train for this booming field by working with your own production-model microcomputer.

We'll explain the principles of troubleshooting and testing your microcomputer and, best of all, we'll show you how to program it to do what you want.

You'll use a digital multimeter, a digital logic probe and other sophisticated testing gear to learn how to localize problems and solve them.

Send for the full color catalog in the electronics area of your choice—discover *all* the advantages of home study with NTS!

NTS also offers courses in Auto Mechanics, Air Conditioning and Home Appliances. Check card for more information.



We believe that training on production-model equipment, rather than home-made learning devices, makes home study more exciting and relevant. That's why you'll find such gear in most of NTS's electronics programs.

For instance, to learn Color TV Servicing you'll build and keep the 25-inch (diagonal) NTS/HEATH digital color TV.

In Communications Electronics you'll be able to assemble and keep your own NTS/HEATH 2-meter FM transceiver, plus test equipment.

But no matter which program you choose, NTS's Project Method of instruction helps you quickly to acquire practical know-how.

2.





Simulated TV Reception

1. The NTS/Rockwell AIM 65

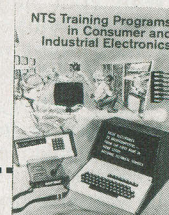
Microcomputer A single board unit with on-board 20 column alphanumeric printer and 20 character display. A 6502-based unit 4K RAM, expandable. 2. The NTS/KIM-1

Microcomputer A single board unit with 6 digit LED display and on-board 24 key hexadecimal calculator-type keyboard. A 6502 based microcomputer with 1K RAM, expandable.

3. The NTS/HEATH H-89 Microcomputer features floppy disk storage, "smart" video terminal, two Z80 micro-processors, 16K RAM memory, expandable to 48K. 4. The NTS/HEATH GR-2001 Digital Color TV (25" diagonal) features specialized AGC-SYNC muting, filtered color and new solid-state high voltage tripler rectifier.

NTS NATIONAL TECHNICAL SCHOOLS

TECHNICAL-TRADE TRAINING SINCE 1905
Resident and Home-Study Schools
4000 SO. FIGUEROA ST., LOS ANGELES, CA. 90037



NATIONAL TECHNICAL SCHOOLS

4000 South Figueroa Street, Dept. 205-090
Los Angeles, California 90037

Please rush FREE color catalog on course checked below

- | | |
|---|---|
| <input type="checkbox"/> MicroComputers/MicroProcessors | <input type="checkbox"/> Auto Mechanics |
| <input type="checkbox"/> Communications Electronics | <input type="checkbox"/> Air Conditioning |
| <input type="checkbox"/> Digital Electronics | <input type="checkbox"/> Home Appliances |
| <input type="checkbox"/> Industrial Technology | <input type="checkbox"/> Color TV Servicing |

Name _____ Age _____

Address _____

Apt. _____ City _____

State _____ Zip _____

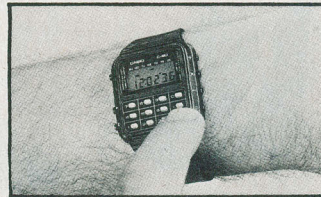
☐ Check if interested in G.I. information.

☐ Check if interested ONLY in classroom training in Los Angeles.

ELECTRONIC BREAKTHROUGH!

Awesome Fingertip Power!

- CASIO C-80 DIGITAL QUARTZ CHRONOGRAPH/CALCULATOR
- THE OLIVETTI WORLD'S SMALLEST PRINTING CALCULATOR/LCD CLOCK



The two wonders on this page are among the best, most wanted, and most useful everyday electronic products in the world.

Each one brings you state-of-the-art function and design and places awesome calculating power at your fingertips. Let's examine these breakthroughs one at a time.

ANATOMY OF YOUR FINGERTIP

The Casio C-80 Chronographic Calculator is the first wrist instrument whose numeric and function command keys are designed so you can operate them with your fingertip. No need to carry a special stylus or look for a pencil with a sharp point whenever you want to calculate something.

The Casio C-80 has an 8-digit read-out. It adds, subtracts, multiplies, divides, and performs chain calculations. Floating decimal tool.

It tells you the time digitally in two zones (accurate within ± 15 seconds a month), and it tells month and date. It's also a stopwatch in hundredths of seconds, with capacity up to 23 hrs., 59 min. 59.99 secs. It gives you both lap and net times as well.

The C-80 weighs much less than metal calculator watches. The case and band are space-age unbreakable plastic, and the LCD face is protected by hard mineral glass.

So far as we know, only one or two stores in New York City have been able to get the C-80. And we've seen it advertised as high as \$75.00 — and that only lets you reserve it, with a long wait for delivery.

You can call our toll-free number for immediate delivery, and charge just \$69.95 (plus \$2.50 insured shipping) to your credit card. Thirty day money-back guarantee, one-year parts and labor warranty.

Just three more points: the battery's included. There's a tiny light to illuminate the display at night. In fact, it's bright enough to help you find your keys if you drop them in the dark. And when you receive your Casio C-80, resist the temptation to press the keys with your fingernail. Not necessary. Just use your fingertips.

WORLD'S SMALLEST PRINTING CALCULATOR!

Besides all the calculating functions you expect, the Olivetti Logos 9 offers you these added features, plus more, thanks to some new technological breakthroughs.

- Measures only 1 inch by 2½ inches by 4 5/8 inches, with full 12 digit liquid crystal display, with floating or fixed position decimal.

- Exclusive paper cartridge system, simply slide up the calculator top and behold the smallest printing system you've ever seen.

- Clear crisp entries on Olivetti's special cartridge paper. Each cartridge lasts for up to 1,300 entries.

(Thirty two rolls...good for three years of use, only \$18.00).

- Incredibly fast printing speed of two lines per second, with print recall. Should your entries exceed unit speed, the Logos 9 will still print each entry.

- Rechargeable batteries (up to 500 recharges per battery).

- Printing head labels all numerical entries with letters. You'll never forget your entries purpose.

- Accumulating memory, plus fully independent memory.

- Digital clock, a totally accurate timepiece.

- Ideal for people who employ, discounts, gross margins, and percentage markups.

- Automatic average: The Logos 9 will automatically compute the average of a group of entries.

- Complete memory recall and display.

- Battery charging and 90 day limited warranty.

- Easy Olivetti service by mail.

CIRCLE NO. 45 ON FREE INFORMATION CARD

Try this amazing pocket calculator today, we're sure that you will agree that the Logos 9 is the most convenient and advanced pocket calculator you've ever seen. If after thirty days, you are not satisfied, return the unit for a prompt refund.

The Olivetti Logos 9 was awarded at the International Consumer Electronic Show 1980 the distinguished position of being the "Most Innovative Product of the Year", and is the best selling pocket calculator in the world.

Try it today.

HERE'S HOW TO ORDER AND SAVE

The C-80 Chronograph/Calculator is \$69.95. The Printing Calculator is \$89.95. That adds up to \$159.90. If you order both for yourself (and don't forget gift possibilities) pay only **\$144.95** for a savings of **\$15.00**.

Or order any two and take \$15.00 off their combined price. You can order today by calling one of our toll-free numbers for immediate delivery. You save on insured shipping charges, as well: just \$2.50 for each order, not each item.

30 DAY MONEY BACK GUARANTEE

When you order, you're protected by our 30-day money back guarantee policy. And each item is additionally covered by a one-year parts and labor warranty. All units come with instructions, and batteries are included.

Right now, call toll-free and charge what you want on American Express, Diners Club, Carte Blanche, Master Card, or Visa.

800-526-2801

800-257-7850

In New Jersey call toll free:
800-322-8650

N.J. residents please add 5% sales tax.

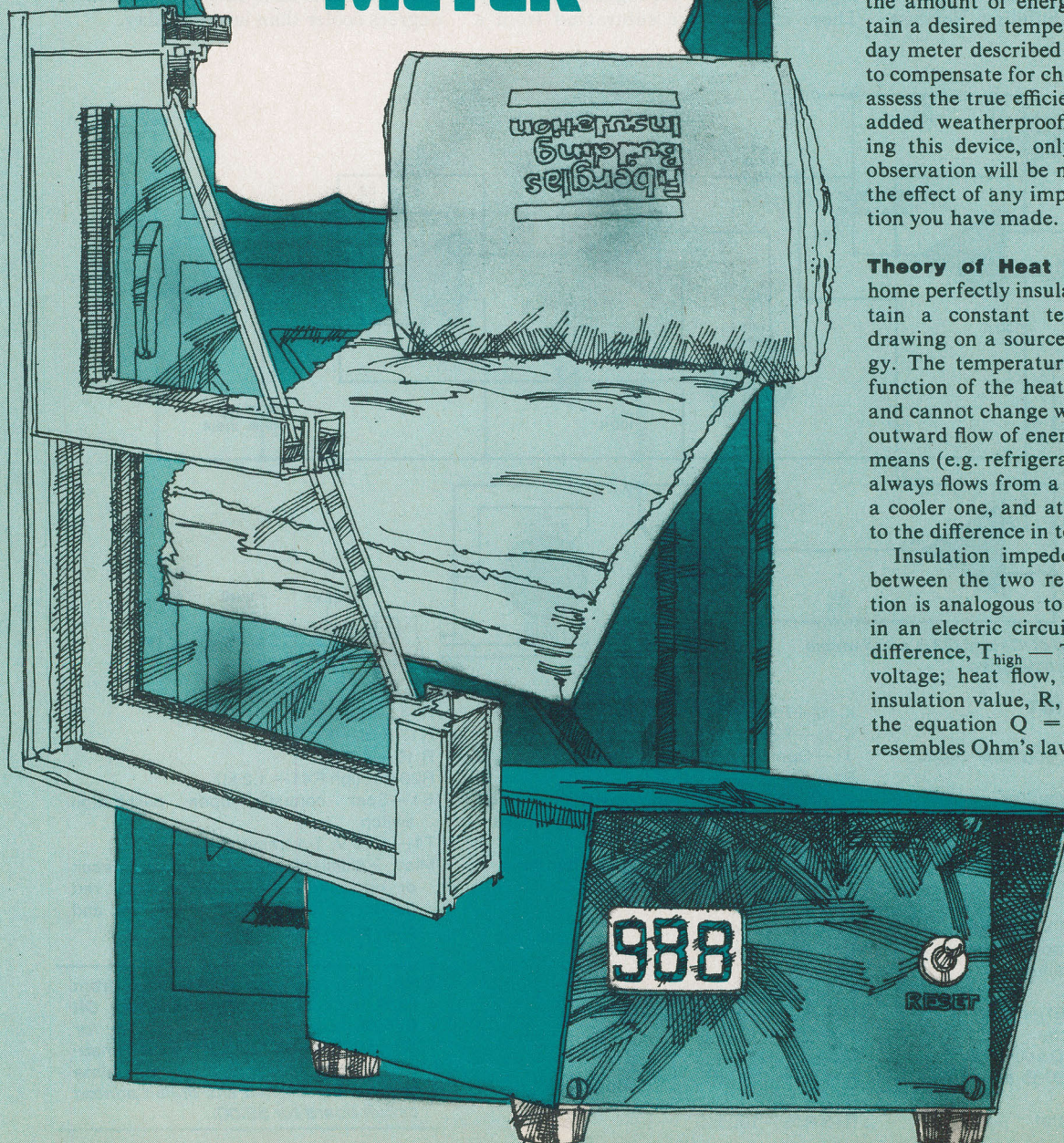
You can also mail your order with check or money order to:

INTERNATIONAL SALES GROUP
MERCURY
THE IMAGINATION PEOPLE®

Dept. PE-9, Lakewood Plaza
Lakewood, New Jersey 08701

BY RUSH W. HOOD

CHECK YOUR HEAT LOSS WITH A DEGREE-DAY METER



Find out how well your weatherproofing and insulation work

Large amounts of money are being spent by homeowners today on insulation, storm windows and other means of reducing energy use and cost for heating homes. Gauging the effectiveness of these improvements, however, often requires months or even years of tabulations. Data garnered from supplier bills are often misleading owing to changing weather conditions that directly affect the amount of energy needed to maintain a desired temperature. The degree-day meter described here will allow you to compensate for changing weather and assess the true efficiency of your home's added weatherproofing. Moreover, using this device, only a day or two of observation will be needed to determine the effect of any improvement in insulation you have made.

Theory of Heat Flow. Were your home perfectly insulated, it would maintain a constant temperature without drawing on a source of additional energy. The temperature of an object is a function of the heat energy it contains, and cannot change without an inward or outward flow of energy. Unless artificial means (e.g. refrigeration) are used, heat always flows from a warmer reservoir to a cooler one, and at a rate proportional to the difference in temperature.

Insulation impedes the flow of heat between the two reservoirs. The situation is analogous to the flow of current in an electric circuit. The temperature difference, $T_{\text{high}} - T_{\text{low}}$, is equivalent to voltage; heat flow, Q , to current; and insulation value, R , to resistance. Thus, the equation $Q = (T_{\text{high}} - T_{\text{low}}) / R$ resembles Ohm's law.

Degree-Day Meter

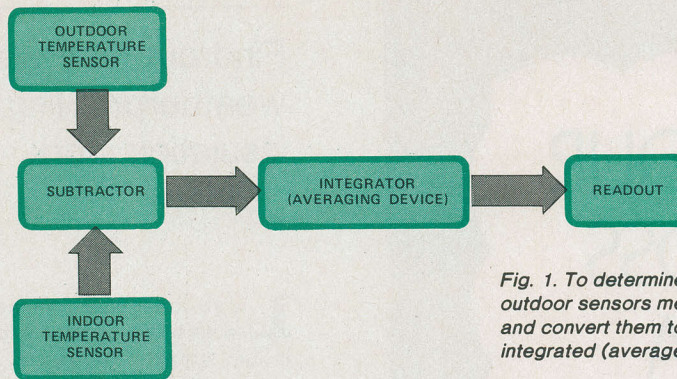


Fig. 1. To determine degree-days, the indoor and outdoor sensors measure temperatures and convert them to voltages, which are subtracted, integrated (averaged) and applied to readout.

If the temperatures inside and outside your home were constant for a long period of time, you could simply measure the temperature difference and the rate of energy use by reading the gas or electric meter and calculate the average insulation value of your building. Because

the temperature of the outside air changes too rapidly to allow such procedure, the degree-day was devised.

A degree-day is computed from temperature readings taken at frequent, regular intervals throughout the day. These readings are subtracted from a

reference temperature, usually 68°F, and the differences are averaged over one day. If a day is reported to have had 15 degree-days, for example, the energy needed to heat your home would have been the same as if outside had been 15 degrees cooler than inside all day.

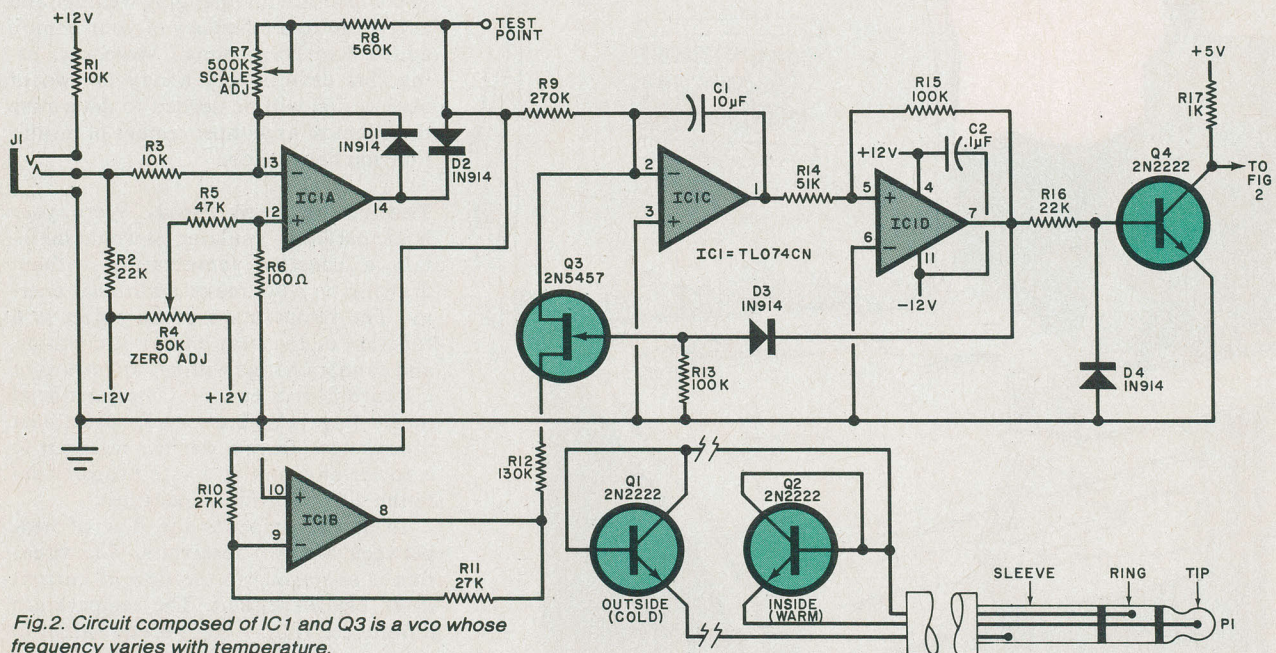


Fig. 2. Circuit composed of IC1 and Q3 is a vco whose frequency varies with temperature.

PARTS LIST

C1—10- μ F, 25-V Mylar or polyester capacitor
 C2—0.1- μ F ceramic capacitor
 C3—1000- μ F, 25-V electrolytic
 C4—100- μ F, 25-V electrolytic
 C5, C6—0.33- μ F, 25-V tantalum capacitor
 D1 through D4—1N914
 D5, D6—1N4001 1-A, 50-V rectifier
 DISP1, DISP2, DISP3—Common-anode display (MAN4610 or similar)
 F1—1-A, fast-blow fuse
 IC1—TL074CN quad BIFET op amp
 IC2—74LS93 binary counter
 IC3, IC4, IC5—74LS90 BCD counter
 IC6, IC7, IC8—74LS47 BCD-to-seven segment decoder
 IC9—7812 + 12-V regulator

IC10—7805 +5-V regulator
 IC11—7912 -12-V regulator
 J1—Open-circuit stereo phone jack
 P1—Stereo phone plug
 Q1, Q2, Q4, Q5—2N2222 transistor
 Q3—2N5457 FET transistor (Radio Shack 276-2028)
 The following are 1/4-W, 5% carbon resistors unless otherwise noted:
 R1, R3—10 k Ω
 R2, R16—22 k Ω
 R4—50 k Ω trimmer potentiometer
 R5—47 k Ω
 R6—100 Ω
 R7—500 k Ω trimmer potentiometer
 R8—560 k Ω
 R9—270 k Ω
 R10, R11—27 k Ω
 R12—130 k Ω
 R13, R15—100 k Ω

R14—51 k Ω
 R17, R18—1 k Ω
 R19—4.7 k Ω
 R20 through R41—1.2 k Ω
 S1—Spst normally open pushbutton switch
 T1—12.6-V, 1-A transformer
 Misc.—Aluminum enclosure, printed circuit or perforated board, IC sockets, red plastic for display window, line cord and plug, strain relief, etc.

Note: The following is available from HLW, P.O. Box 1026, Beaverton, OR 97075: complete kit of parts for \$97.50, plus \$3.50, postage and handling. Also available from the same source is an etched and drilled printed circuit board for \$9.00.

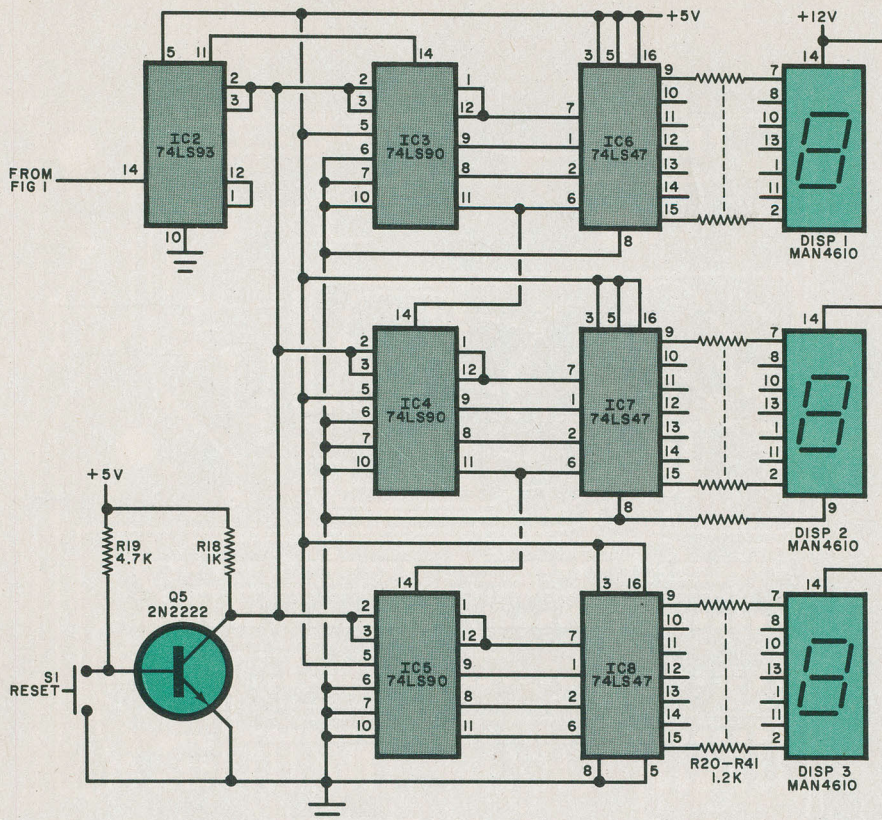


Fig. 3. Other than the divide-by-16 counter (IC2), digital circuit is conventional 3-digit counter, decoder and display.

Degree-days reported by your local weather service can be useful, but they may not be sufficiently accurate for critical measurements. Your inside temperature may not be the standard 68 degrees, and may vary through a 24-hour period. This degree-day meter project calculates the degree-days from the temperatures inside and outside your particular home.

How it Works. The meter continuously senses the indoor and outdoor temperatures, subtracts them and integrates the difference. Analog and digital circuit techniques are used to maintain the integration accuracy over long periods of time and to provide a numerical readout. The block diagram in Fig. 1 summarizes, in an easy-to-follow method, the device's operation.

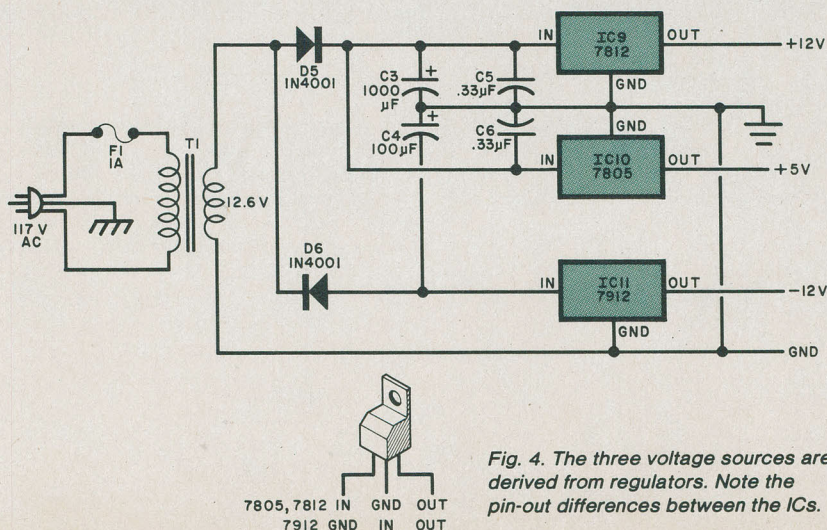


Fig. 4. The three voltage sources are derived from regulators. Note the pin-out differences between the ICs.

Circuit Design. The subtracting and integrating circuits are shown in Fig. 2. Indoor and outdoor temperatures are sensed by silicon transistors *Q1* and *Q2*, which are connected as diodes. A constant current passing through a silicon diode junction develops a voltage drop that varies approximately linearly with temperature at a rate of 1.2 mV/°F. The two sensors are connected in series opposition, so that the voltages across them are subtracted. The difference voltage taken from the junction of the two transistors is proportional to the difference between the two temperatures.

Integrated circuit *IC1A* supplies enough gain to boost the difference signal so that it varies at a rate of 100 mV/°F. It also acts as a half-wave rectifier, making the meter insensitive to situations in which the outside temperature exceeds the inside temperature, which could happen on sunny days. Sections, B, C, and D of *IC1* and FET *Q3* with its associated components form a voltage-controlled oscillator (VCO) whose average output frequency is 160 cycles per degree-day. The output of *IC1A* is coupled to the inverting (−) input of integrator *IC1C* (which averages the signal) via *R9* and to inverter *IC1B* through *R10*. The output of *IC1B* is coupled through *R12* and FET switch *Q3* directly to the inverting input of *IC1C*. When *Q3* is turned on, its drain-to-source channel resistance, coupled with *R12*, is one-half the value of *R9* and the *IC1B* signal to *IC1C* is twice that from *R9* and is of the opposite polarity. Thus, the integrator is fed with either a plus or minus 100-mV/°F signal depending on the state of switch *Q3*. A negative voltage applied to the gate of *Q3* turns the transistor off.

The integrator output is coupled to comparator *IC1D*, which has a hysteresis of 10 volts. The output of *IC1D* at pin 7 is either +10 V or −10 V depending on the polarity of the input signal with respect to ground. This output is coupled to the gate of *Q3* through diode *D3*. Assume that the integrator is developing a positive-going ramp at its output. When this reaches the trigger voltage of the comparator, the latter rapidly switches to its maximum positive output, which reverse biases *D3*. This turns *Q3* on and routes the inverted signal to the integrator, which now develops a negative-going ramp until the comparator switches to its maximum negative output. This turns off *Q3*, and the cycle is repeated.

The output of comparator *IC1D* is converted into a TTL-level signal by *Q4*. Diode *D4* is used to limit the negative-going signal to the base of *Q4*, while *R16* is the base-current limiting resistor.

Degree-Day Meter

The TTL signal is used to drive the conventional 3-digit counter, decoder and display shown in Fig. 3.

The 160 cycles per degree day output from *Q4* is divided by 16 in *IC2* to provide a square wave having one cycle per tenth of a degree day. This signal is coupled to pin 14 of LSB counter *IC3*. Zero set is provided by depressing RESET pushbutton *S1* which places a ground on pins 2 and 3 (reset to zero) of the four counting ICs. Note that *DISP2* has its decimal point (pin 9) permanently activated by a resistor to ground.

The power supply, shown in Fig. 4, provides +5 volts for the TTL logic, ± 12 volts for the analog circuit, and +12 volts for the seven-segment common-anode readouts. Be sure to observe the pin-out difference between the regulator ICs.

Construction. The meter can be constructed using the foil pattern shown in Fig. 5, or perforated board and Wire-Wrap techniques. If you design your own layout, arrange it so that the digital portion—especially *IC6*, *IC7* and *IC8*—are along one long edge. In this way, the three-digit display can be mounted on a separate small board that uses the display current-limiting resistors for electrical and mechanical interconnection.

Select an enclosure large enough to accommodate the circuit board and *T1*. A rectangular front-panel cutout (covered by a red filter) should be made for the three-digit display. RESET switch *S1* is also mounted on the front panel. Jack *J1*, the fuseholder and an insulating grommet for the line cord can be mounted on the rear apron. The 5-volt regulator *IC10* and +12-volt regulator *IC9*, which handle appreciable power, should be mounted to the rear apron to allow this wall to act as a heat sink. Capacitors *C5* and *C6* can be soldered directly to the respective pins on their regulators.

The sensor circuit (Fig. 2) is made by soldering the base and collector of each transistor together to form one lead. Select a length of slender two-conductor zipcord having sufficient length to reach the meter from each selected location. At one end, separate the leads for an inch or so. Remove about 1/4-inch of insulation and slip a short length of narrow heat-shrinkable tubing on each lead, solder one to the base-collector lead and the other to the emitter lead. Slide the heat-shrinkable tubing down over the soldered connection and shrink it. The outdoor sensor (*Q1*) can be encapsulated in epoxy if it is not mounted in a weatherproof location. After both sensors are fabricated, connect the far ends of both pairs to the stereo-type phone plug.

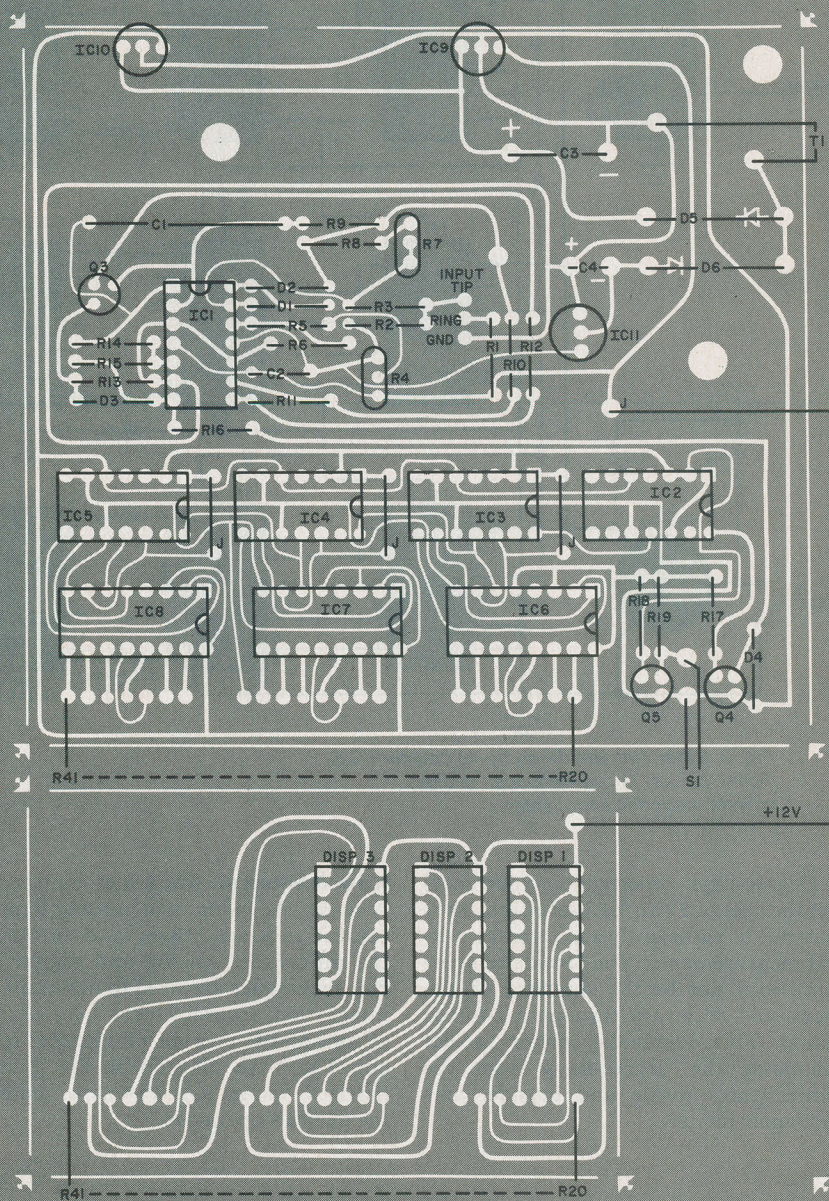
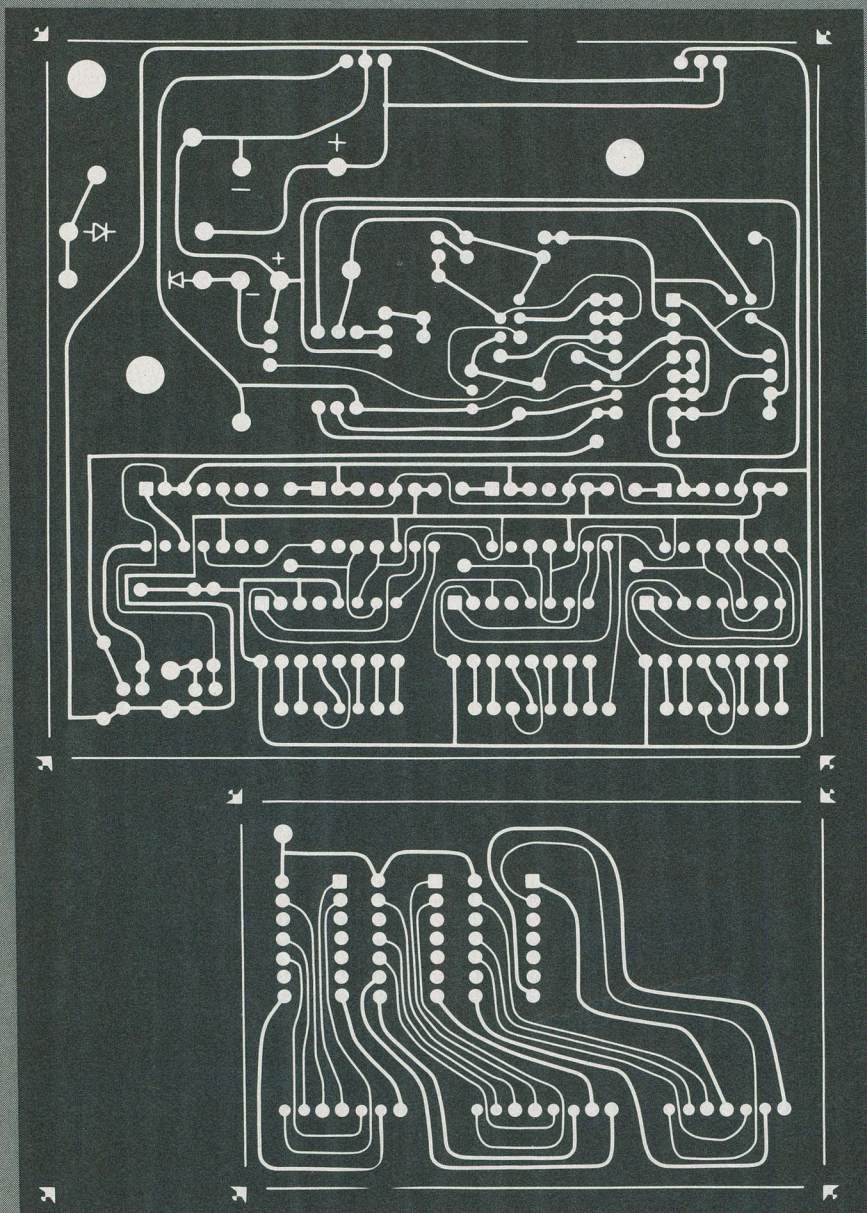


Fig. 5. The large foil pattern (opposite) is for the electronic circuit, while the smaller board below it is for the display. The two boards are interconnected by the current limiting resistors. Installation of these and other components is shown above.



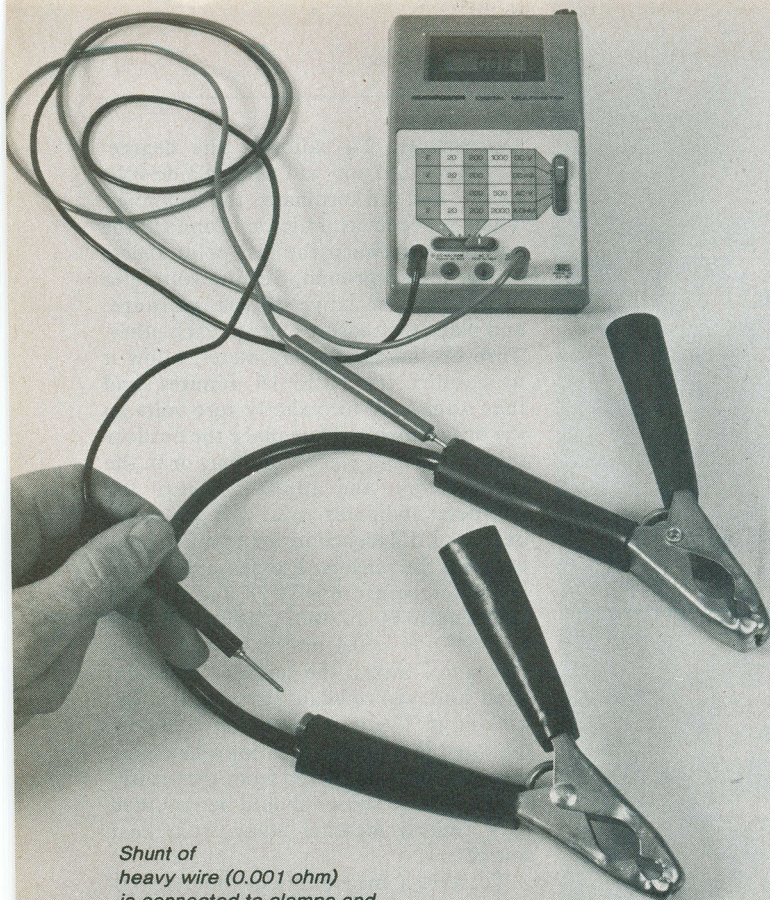
Operation. To calibrate the degree-day meter, all you will need is a dc voltmeter and an ordinary thermometer. Then proceed as follows: Connect the voltmeter between the test point shown in Fig. 2 and ground. Set the voltmeter for its most sensitive dc voltage range, and place the sensors close to each other. Turn on the degree-day meter, allow it to stabilize for 10 to 15 minutes, and then adjust *R4* for exactly zero volts on the dc voltmeter. Then place the outdoor sensor in a cool place (outdoors or in the refrigerator), and adjust *R7* until the voltmeter indicates -0.1 volt for every degree of difference in the temperatures between the sensors. For example, if the inside temperature is 70°F and the outside sensor is at 40°F , adjust *R7* for $(70-40) \times -0.1$ or -3.0 volts at the test point. Install the sensors where desired and you're ready to measure degree-days. The outside sensor should be mounted in a shaded location away from the house and protected from the weather. The inside sensor should be mounted in a central location away from heat sources.

To start a measurement, depress RESET push button *S1*. The display should be "00.0" and should be observed to increment through the day if the outside sensor is cooler than the inside sensor. The greater the temperature difference between outside and inside, the faster the display will increment.

To measure actual energy efficiency of your home, you must measure the energy used over the same time interval that you measure degree-days. Your utility company can tell you how to read your gas or electric meter, or an elapsed-time meter may be connected to measure the total length of time the furnace is heating. Simply divide the energy (therms, BTUs, or kilowatt hours) by the degree-days to obtain a figure in energy per degree-day. This number should be nearly constant from day to day, and any improvement you make in your building's heat retention will lower this factor.

The degree-day meter can also be used to check your home's heat gain while air-conditioning is in use. Simply reverse locations of the inside and outside sensors. It is suggested that regular records be kept throughout the season to encourage conservation. It will be obvious from the efficiency determinations when real improvements are made in the weatherization of your home. (Note that frequent opening and closing of doors is tantamount to a reduction in insulation efficiency.)

Use of the degree-day meter can help a homeowner accurately estimate the payback period on money spent weather-proofing his building. \diamond



Shunt of heavy wire (0.001 ohm) is connected to clamps and test probes plug into tip jacks in clamp handles to measure large currents.

Measuring Large Currents with a DMM

By using the proper shunt, a DMM can measure up to hundreds of amperes

BY ROBERT H. JOHNS

THE current-measuring function of digital multimeters (DMMs) is usually limited to 1 or 2 amperes at most. How then can one use a DMM to measure the tens or hundreds of amperes that may be associated with automotive starter and battery-charging systems, or heavy-duty appliances? The answer is: use a high-current shunt.

A DMM set to its current function really measures the voltage developed by a current in a known shunt resistance. Since all DMMs measure dc voltages, an internal rectifier is used to convert ac voltages to dc. Even though the DMM is operating as a voltmeter, the current function display is calibrated in milliamperes or amperes.

If the resistance of the shunt is low, a large current through it will develop only a small voltage drop. For example, as shown in Fig. 1, a shunt resistor of 0.001 Ω (one milliohm) will produce a drop of 0.001 volt for each ampere that flows through it. If a DMM is capable of displaying 0.001 volt at the least-significant digit (the one on the extreme right), this range can be interpreted directly in amperes. Thus, a display of 0.028 represents 28 amperes flowing through the 0.001- Ω shunt resistor.

Then there is the matter of wattage. Since the shunt is a resistor, a current

flowing through it will develop heat that the resistor must dissipate. The power dissipated as heat can be calculated as $W=I^2R$, where I is the current and R the resistance of the shunt: thus a current of 50 amperes would develop 2500 milliwatts of heat.

Note that the shunt is, for all practical purposes, a short circuit and should not be connected directly across a power source. *Always place the shunt in series with the load!*

In all metallic elements including copper wire, resistance increases with temperature. Therefore, the thicker the wire the less the resistance change and the better the tolerance to I^2R heat build-up. Ambient temperature also affects conductor resistance. Commercial shunts often use manganin, an alloy that was specially developed to have very little resistance change with temperature. The typical experimenter may not have access to a manganin shunt, but he can use a heavy-duty cable specifically designed for very high current work—automotive jumper cables using multi-strand #10 wire.

Shunt Construction. Remove the clamps from one of the jumper cables and cut the cable to exactly 13.5 inches. Then, as shown in Fig. 2, remove 1.5

inches of the heavy plastic insulation from each end, being careful not to nick the wire strands. This leaves 10.5 inches of insulated wire. The electrical connections should be 11.0 inches apart, yielding a resistance of 0.001 ohm, taking into account the resistance of the clamps and soldered connections. Carefully separate one or two strands of wire from each end and cut them so that the ends are as close as possible to 11.0 inches apart. (Bear in mind that different samples of this wire may have slightly different resistances due to variations in manufacture.)

Carefully tape a tip-jack connector (see Figs. 2 and 3) to the end of the plastic insulation, then solder the loose wire strands to the electrical connector. Do the same at the other end.

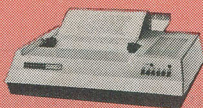
Carefully solder together and mount the remaining bundle of wires to the hand clamp. Use a high-wattage soldering iron to make a secure electrical connection. Replace the heavy plastic sleeve over the connection. Do the same at the other end.

If desired, smaller clamps, or even banana plugs can be used at the ends of the shunt cable as shown in Fig. 4. Regardless of the termination used, make sure that the high current flows in the shunt and its end connectors and not through

(Continued on page 94)



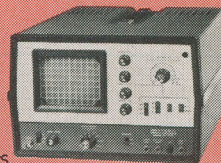
All-In-One
Computer



Computer
Peripherals



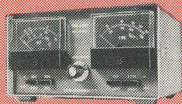
Amateur Antenna Tuner



Oscilloscopes



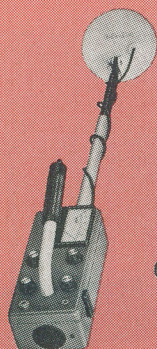
Giant screen
projection TV



Dual Wattmeter



Hand-held
Digital Multimeter



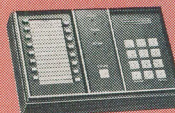
Groundtrack®
Metal Locator



Digital Electronic
Scale



Car Thermometer



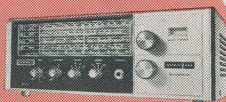
One-button
Phone Dialer



Pro-Series Audio
Components



Speedometer/
Tachometer



4-band Shortwave
Radio

FREE

HEATHKIT® CATALOG



400 electronic kits: test instruments, computers, amateur radio gear, electronic educational programs, color televisions, stereo components, R/C gear, home products, energy conservation devices, marine and aviation gear, and more — things you've always wanted and needed, now at low kit prices from Heath.

Discover the fun of kit building — it's a great way to relax in your spare time and share a rewarding

pastime with your whole family. The useful items you build will reflect the pride of your craftsmanship, too. The famous Heathkit illustrated manuals make it easy for anyone to build reliable, professional-quality kits.

SEND FOR YOURS NOW!

The 104-page catalog is Free! If coupon is missing write:
Heath Company, Dept. 010-692, Benton Harbor, MI 49022

CIRCLE NO. 30 ON FREE INFORMATION CARD

Heathkit®

Heath Company, Dept. 010-692
Benton Harbor, MI 49022

Send my free Heathkit Catalog now.
I am not currently receiving your catalog.

Name _____

Address _____

City _____ State _____

CL-727 Zip _____

**FREE
CATALOG**

Heathkit products are displayed, sold and serviced at Heathkit Electronic Centers* nationwide. Consult your telephone directory white pages for location.
*Units of Veritechnology Electronics Corporation. Some retail prices may be slightly higher.

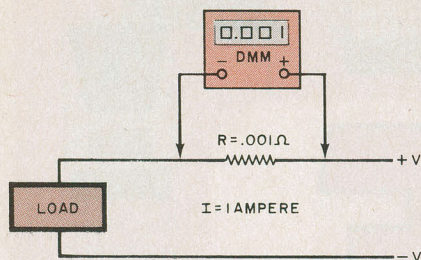


Fig. 1. Current can be read by measuring voltage drop across a known resistance.

PARTS NEEDED

Automotive jumper cables, tip jacks (Lafayette 32A65105, Allied 920-0292, Callectro F2-879 or 30-1080, or similar), or combination tip jack-and-banana connector (Lafayette 32A64850, Callectro F2-883, or similar), 50-ampere clamps (Mueller PK46A or similar), electrical tape, solder.

Note: A 0.001-Ω shunt is available for \$5.95 plus \$1 shipping and handling from R. H. Johns Scientific Instruments, 3379 Papermill Rd., Huntingdon Valley, PA 19006. Pennsylvania residents, please add 6% sales tax.

the jacks that feed the DMM.

If your DMM does not indicate to tenths of a millivolt, a 0.01-ohm shunt having a current sensitivity of 0.1 ampere per millivolt can be built. With this shunt, a DMM indication of 0.016 volt represents a current flow of 1.6 amperes. Use the same approach as previously described, but use 66 inches of #12 stranded copper wire with the tip jacks 65 inches apart.

To measure ac current, a convention-

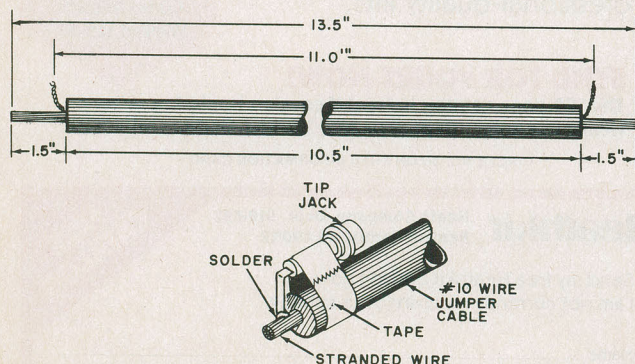


Fig. 2. As described in the text, a 0.001-ohm, high-power shunt can be constructed as shown here from a conventional battery jumper cable and a pair of standard tip jacks.

al ac outlet box having one or two appliance sockets mounted on it with the 0.001-ohm shunt in series with one of the leads can be used. There is enough room within the enclosure to allow the shunt to be placed inside and the two tip jacks to be mounted on the upper plate. This approach is shown in Fig. 5. In this mode, use the ac voltage function of the DMM. Keep in mind that the tip connectors may be "hot" to ground so take all safety precautions when using this method of current measurement.

Accuracy. The shunt described in this article will be accurate to within approximately $\pm 3\%$. This value is dependent on the actual ohmic value of the shunt and resistance changes due to heating (I^2R losses).

The 'shunts' accuracy can be improved by connecting the shunt in series with a lab-grade ammeter, a suitable load and a power source capable of delivering several amperes. With a known value of current flowing (lab ammeter indication), note the DMM readout. It should be the same as the ammeter display. If not, the shunt can be trimmed until the two meters coincide. The amount of current flowing is not important, but the two meters should display the same readout. It is a relatively easy job to re-adjust the contact position of the tip jack connectors on the shunt to adjust the DMM indication.

If you wish to build your own "standard" resistor, consult the wire tables in any engineering book, or the ARRL *Radio Amateurs Handbook*. These list the

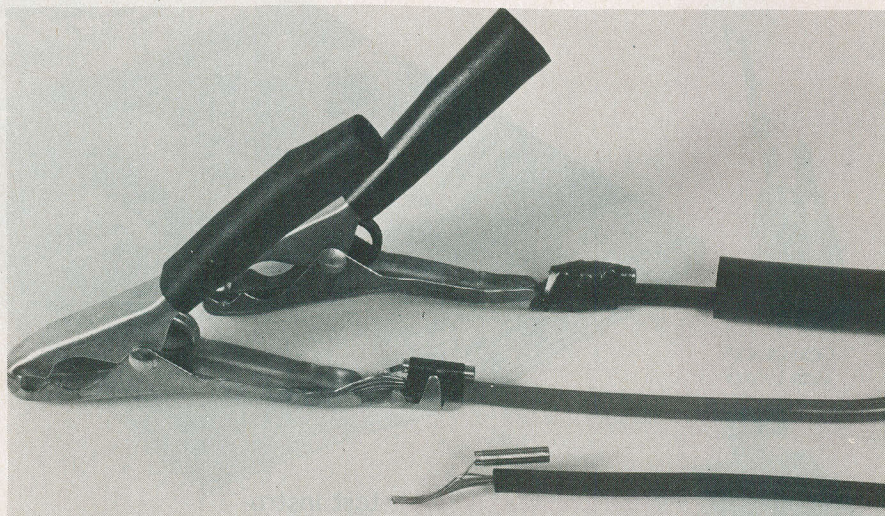


Fig. 3. Assembly of the tip jack and shunt cable to the clamp. After soldering, the large plastic sleeve is placed over the joint and clamp handle.

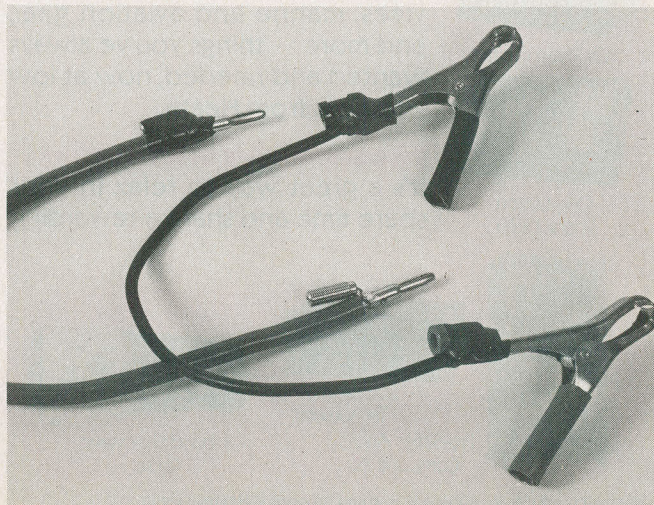
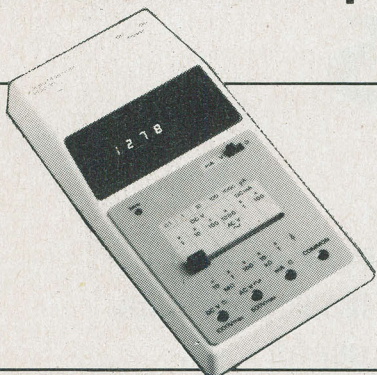


Fig. 4. Shunts can be terminated in banana plugs or small clips as shown here.

Sinclair Multimeters

Repeatable Quality at Unrepeatable Prices!
Take advantage of this super special offer of professional quality DMMs.



PDM35

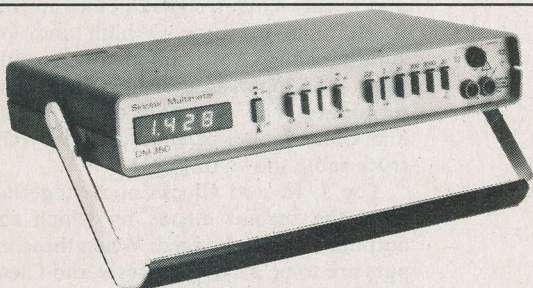
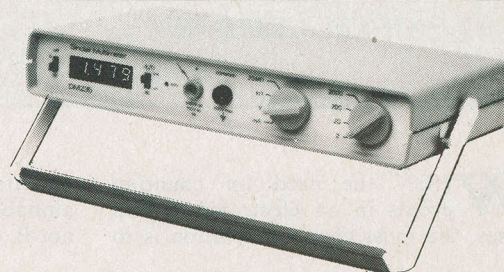
\$39.95

Hand-held 3 1/2 digit LED Multimeter
 1% basic DCV Accuracy
 16 ranges: DC/AC Volts, DC Current, Ohms.
 Resolution 1mV / 0.1nA / 1ohm
 Ranges to 1000V / 100mA / 10M
 Battery operated (PP3) or AC Adaptor
 Complete with test leads and carrying pouch

DM235

Bench/Portable 3 1/2 digit LED Multimeter
 0.5% basic DCV Accuracy
 21 ranges: DC and AC Volts and Current, Ohms
 Resolution 1mV / 1μA / 1ohm
 Ranges to 1000V / 1A / 20M
 Battery operated (4 'C' cells) or AC Adaptor
 Complete with test leads

\$69.95



DM350

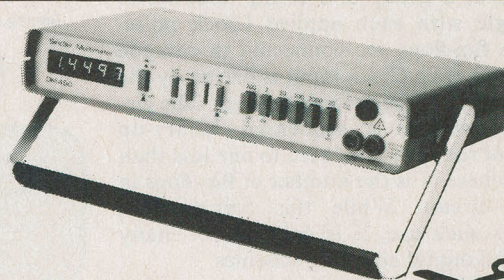
\$99.95

Bench/Portable 3 1/2 digit LED Multimeter
 0.1% basic DCV Accuracy
 34 ranges: DC and AC Volts and Current, Ohms
 Resolution 100μV / 1nA / 0.1ohms
 Ranges to 1200V / 10A / 20M
 Battery operated (4 'C' cells) or AC Adaptor
 Complete with test leads

DM450

Bench/Portable 4 1/2 digit LED Multimeter
 0.05% basic DCV Accuracy
 34 ranges: DC and AC Volts and Current, Ohms
 Resolution 10μV / 0.1nA / 0.01 ohms
 Ranges to 1200V / 10A / 20M
 Battery operated (4 'C' cells) or AC Adaptor
 Complete with test leads

\$129.95



please send me

_____ PDM35 Hand-held DMM @ \$39.95 each : \$ _____
 _____ DM235 Bench/Portable DMM @ \$69.95 each : \$ _____
 _____ DM350 Bench/Portable DMM @ \$99.95 each : \$ _____
 _____ DM450 Bench/Portable DMM @ \$129.95 each : \$ _____
 _____ AC Adaptor for PDM35 @ \$4.95 each : \$ _____
 _____ AC Adaptor for DM235 @ \$4.95 each : \$ _____
 _____ AC Adaptor for DM350 @ \$4.95 each : \$ _____
 _____ AC Adaptor for DM450 @ \$4.95 each : \$ _____

Shipping/Handling at single rate per order : \$ 5.00*
 New Jersey residents add appropriate Sales tax: \$ _____

TOTAL : \$ _____

I enclose

☐ Check ☐ Money Order ☐ Master Charge ☐ Visa
 (Allow 2 - 3 weeks clearance time for personal checks)
 Credit Card No. _____ Exp. Date _____
 NAME _____

STREET _____

CITY _____ STATE _____ ZIP _____

SEND TO: NJS Technology Inc.
 P.O. Box 8247
 Haledon
 New Jersey
 07538

PE

Tel. (201) 790 3141

*Continental USA only

SPECIAL COUNTER CIRCUITS FOR EXPERIMENTERS

BY PATRICK J. DELANEY

Various combinations of the basic J-K flip-flop circuits provide many useful digital counting schemes

WHEN the need for counting events in an electronic system arises, the most common solution is to

use an asynchronous digital ripple counter. This circuit, shown in Fig. 1, consists of a group of J-K flip-flops set to toggle with each applied Clock pulse. The flip-flops are connected in cascade so that each Clock input is driven by the Q output of the preceding stage. The circuit provides a sequential binary-up count ranging from zero to one less than 2^N where N is the number of flip-flops in the circuit. While this arrangement finds wide use, it is only one of many useful digital counting schemes.

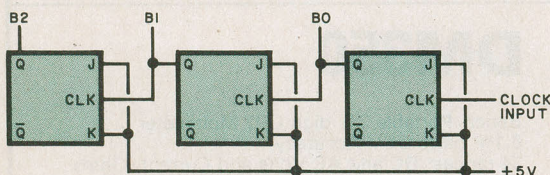
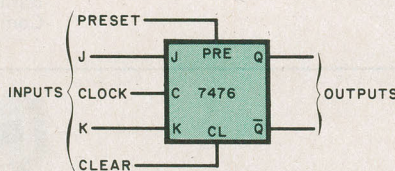


Fig. 1. Basic three-stage synchronous ripple counter.

Special counters make up a major class of flip-flop circuits. However, before these advanced configurations can be described in detail, a review of the J-K flip-flop is in order. A 7476 will be used as an example.

As shown in Fig. 2, a J-K flip-flop typically has five inputs and two outputs. The five inputs are Preset, Clear, Clock, J and K, while the two outputs are variously referred to as Q and not-Q, or some other alphabetic labels indicative of a variable and its complement. When a chain of flip-flops is used, the



INPUTS		OUTPUTS
PRESET	CLEAR	Q
0	0	Indeterminate (never used)
0	1	1 (SET)
1	0	0 (RESET)
1	1	Determined by J, K, and clock

Fig. 2. Details of the 7476 flip-flop and its truth table.

Preset and Clear inputs take precedence over all other inputs and are active low. This means that logic zero applied to the Preset input forces the Q output high (1). Alternately, Q would be forced low (0) by applying a logic zero to the Clear input. If both the Preset and Clear inputs are 1, the flip-flop's state

will be determined by the J, K, and Clock inputs.

The last of the four possible combinations of these inputs is 0 for both Preset and Clear. This is contradictory in that it attempts to force Q high and low simultaneously (an impossible condition). The logic state of Q is thus indeterminate. The operation of the Preset and Clear inputs is summarized by the truth table shown in Fig. 2.

The J, K, and Clock inputs together form the second means by which the outputs may be changed. When these inputs are to be used, the Preset and Clear terminals are both tied high. When the J and K inputs are supplied signals as shown in Fig. 3, each time the Clock input is forced to switch from a logic 1 to a logic 0 (a negative edge), outputs take on the appropriate values. It should be noted that the J and K inputs alone have absolutely no effect on the flip-flop's output state. These two levels are clocked into the flip-flop by a one-to-zero transition at the Clock input. Figure 3 illustrates the effect of the four possible combinations of the J and K inputs on the Q output.

INPUTS			OUTPUT
CLOCK	J	K	Q
↓	0	0	Previous value
↓	0	1	0 (RESET)
↓	1	0	1 (SET)
↓	1	1	TOGGLE

Fig. 3. Effect of the J-K inputs on the Q output of the 7476.

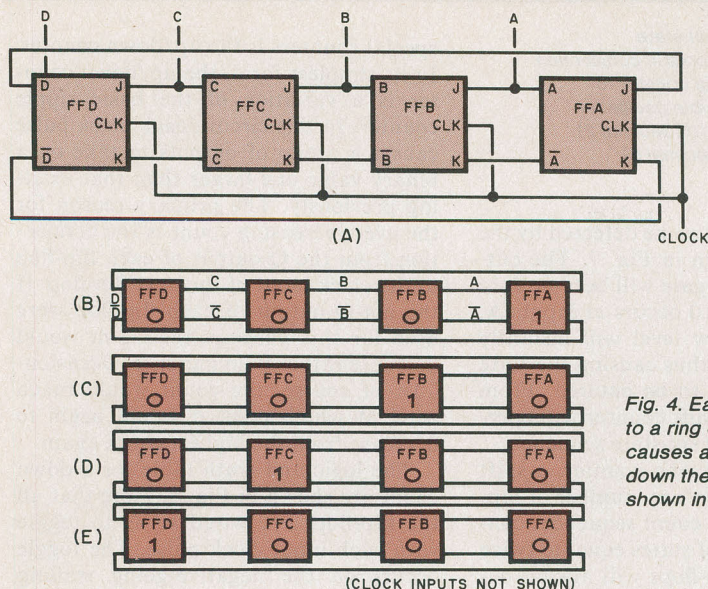


Fig. 4. Each clock pulse to a ring counter (A) causes a logic 1 to "walk" down the counter as shown in (B), (C), (D), and (E).

If both J and K equal 0, and a negative-going Clock pulse occurs, the Q output will remain unchanged. If J is equal to 1 and K equals 0 during the Clock edge, Q will become a logic 1 (set). When J equals 0 and K equals 1, a Clock pulse will force Q to equal 0 (reset). Finally, if J and K equal 1, the Clock will force Q to change its state or toggle. That is to say: if Q had been 0, it becomes 1 and if Q had been 1, it becomes 0.

Now that the operation of the J-K flip-flop is firmly within grasp, let us examine one of the special counters.

Ring Counter. A simple synchronous ring counter is shown in Fig. 4A. Note that the outputs of flip-flop D are fed back to the J and K inputs of flip-flop A, thus forming a "ring." The clock feeds all four clock inputs simultaneously. This circuit differs from most other counters in that its entire operation depends on the initial (power-up) states of its flip-flops. If, for example, output A equals 1 while outputs B, C and D equal 0 as in Fig. 4B, then the application of a single Clock pulse will set B, but Reset A, C and D because the J and K inputs of B were 1 and 0 (the condition for Set) the instant before the Clock pulse, but the J and K inputs of all of the other flip-flops were 0 and 1 respectively. The new condition is shown in Fig. 4C. The next Clock pulse will set C and reset A, B and D, as shown in Fig. 4D. Figure 4E shows how a third Clock pulse will Set D and Reset A, B and C. The final Clock pulse will cause A to set once again, and the cycle will repeat. Note that a lone 1 is shifted from right (A) to left (D) and then back around again. This changing pattern is responsible for the circuit's name. The 4-bit pat-

tern shifted through the group of flip-flops, or register as they are collectively called, is not limited to a single 1, but can be any one of many patterns. These bit patterns can be forced into the register, before the application of Clock pulses, by the use of the Preset and

CLOCK	D	C	B	A
1	0	0	0	1
2	0	0	1	0
3	0	1	0	0
4	1	0	0	0
5	0	0	0	1
6	0	0	1	0
7	0	1	0	0
8	1	0	0	0
9	0	0	0	1
10	0	0	1	0
11	0	1	0	0
12	1	0	0	0

Fig. 5. Ring counter truth table shows how a 1 moves through the counter with successive clock pulses.

Clear inputs. More complicated bit patterns can be generated by using more flip-flops.

Ring counters are used primarily in the production of complex waveforms that generate timing pulses for computers, music synthesizers and similar systems. The voltage-versus-time waveform

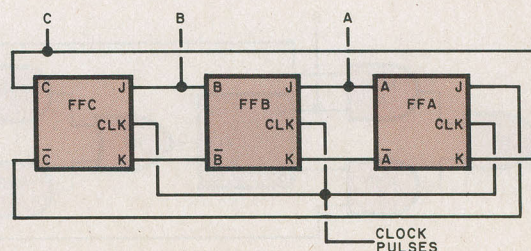


Fig. 6. Note the feedback from the last flip-flop to the first in a shift counter (left) with the truth table shown at right.

CLOCK	C	B	A	DECIMAL
↑	0	0	1	1
↑	0	1	1	3
↑	1	1	1	7
↑	1	1	0	6
↑	1	0	0	4
↑	0	0	0	0
↑	0	0	1	1
Sequence begins again				

resulting from the truth table in Fig. 5 is easily obtained by simply turning the column on its side, and drawing a 5-volt waveform for each 1 and a zero-volt waveform for each 0. Note that the negative-going edge of the Clock triggers each transition of the outputs.

Shift Counters. A small change in the feedback from the last to the first flip-flop of a basic ring counter produces the shift counter shown in Fig. 6A. Unlike the ring counter, the shift counter is usually used as a synchronous event counter rather than as a waveform generator. Shift counters can easily produce any even modulus (number of states) count at extremely high rates of speed, with illegal states and high power consumption and component count being the only drawbacks. Another difference between the ring counter and the shift counter is that the latter does not have to be Preset to a specific pattern or starting state. The shift counter can naturally fall into the correct counting sequence.

A typical count sequence for a three-bit shift counter is shown in Fig. 6B. Whenever a Clock pulse occurs, the feedback connection between flip-flops C and A causes the inverse of the state of flip-flop C to be loaded into flip-flop A. This means that, when C = 0 before a Clock pulse, A will become the opposite of C (1) after the pulse ends. Conversely, if C is a 1 just before the Clock pulse, A will become a 0. This odd, but repetitive count scheme will produce the decimal count 1,3,7,6,4,0, which is obtained by converting each three-bit number in Fig. 6B to its decimal equivalent.

One question that often arises is: "What will happen if the state 010 or 101 occurs?" Since neither of these two states is part of the normal counting sequence, their effects should be determined. It has already been established that the state of flip-flops A and B will ultimately be shifted to flip-flops B and C respectively, and that the inverted contents of C will be shifted into A after each Clock pulse. It is clear, then, that the state 010 (decimal 2) will force B to become the former state of A, C to become the former state of B, and A to become the inverse or opposite of C. It is

counter circuits

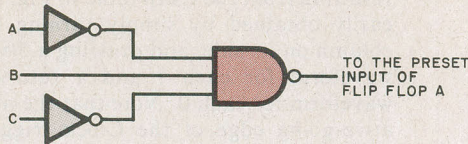


Fig. 7. Illegal state detector works in conjunction with the ring counter to avoid possible oscillation between 010 (decimal 2) and 101 (decimal 5).

as if all of the bits have shifted left by one position, while the most significant bit became complemented and replaced bit A. Thus, illegal state 010 (decimal 2) gives way to state 101 (decimal 5), while state 101 (decimal 5) gives way to the original state 010 (decimal 2). This means that either state, once entered, will cause an oscillation back and forth from decimal 2 to decimal 5, and the normal six-state count sequence will never be entered.

Since the initial application of power to a series of flip-flops creates a random state, it is possible that one of the two undesirable, illegal states will be entered at power-up. To prevent the 2-5-2-5 oscillation from persisting, a series of gates must be added to the basic shift counter. The purpose of this gating arrangement is to detect one of the illegal states and force legal counting to resume. Once the legal counting sequence begins, it continues to exclude the two undesired states.

Logic state 010 can be detected by the arrangement shown in Fig. 7. The output of the NAND gate will become zero only when state 010 occurs at inputs A, B and C. This low level will instantly Preset flip-flop A, thus causing the state 011, or decimal-3 to be entered. From this point on, the shift counter will operate only in its legal six-state sequence.

Just as with the ring counter, a shift counter may employ any number of flip-flops. One or more count sequences containing a number of states equal to twice the number of flip-flops will always occur. Illegal states will also frequently exist and must be prohibited from occurring through the use of circuits similar to that of Fig. 7. It is left to the reader as an experiment to prove that a four-bit shift counter would produce two eight-bit sequences, one of which would generate very odd waveforms indeed!

Up/Down Counters. The last type of circuit falling into the category of

special counters is the up/down counter. In its simplest form, the up/down counter is a variation of the basic ripple counter. In this circuit, each clock pulse causes a group of outputs to take on a binary value one larger than that existing previously. The primary reason for the ever-increasing count is the connection from the Q output of each flip-flop to the clock input of the next flip-flop. If the not-Q output of each flip-flop were used for this purpose, the count would decrease rather than increase. Occasionally, of course, the count would reach zero, at which point it would begin to decrease from the highest count again.

The logic and truth table for a down count are shown in Fig. 8. Note that all the flip-flops are wired so as to toggle with each input clock pulse. The toggle occurs on the negative-going trailing edge of the transition from 1 to zero. For example, the not-Q output of flip-flop A acts as a clock pulse for flip-flop B. Flip-flop B will not toggle (change state) each time the master clock input produces a negative edge, but rather when the not-Q output of flip-flop A switches from 1 to zero. In much the same fashion, flip-flop C responds only to the negative clock edges provided by the output of flip-flop B. The resulting count can clearly be seen to decrease rather than increase in the manner of a standard up ripple counter. A counting circuit that counts solely up or down can often be useful, but a circuit with the ability to count both up and down would in general, be even more useful. The previous discussion indicates that any ripple counter can be changed from count up to count down through simple rewiring.

However, true versatility can be achieved only by electronic control of the counting direction, using a circuit such as that shown in Fig. 9. This circuit makes use of the gating, or switching property of AND gates E and F. That property can best be summarized as follows whenever one input to the AND gate is a logic 1, the gate is said to be enabled, and the remaining gate input will be switched through to the output as if the gate were a piece of conducting wire. The inverter at the count up/down input will cause only the E pair of AND

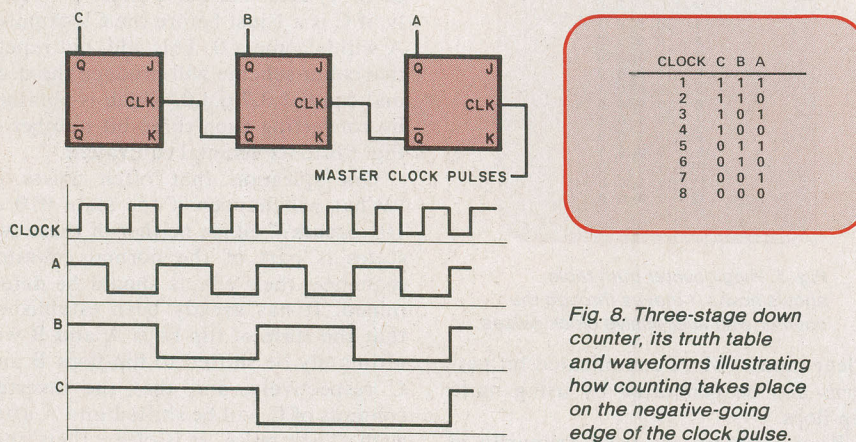


Fig. 8. Three-stage down counter, its truth table and waveforms illustrating how counting takes place on the negative-going edge of the clock pulse.

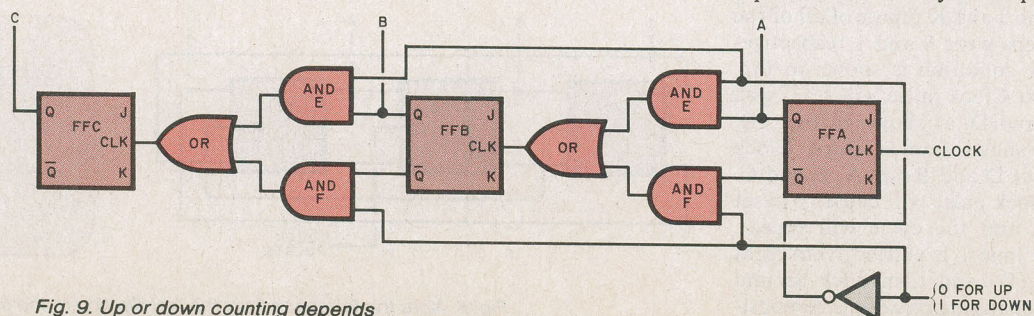


Fig. 9. Up or down counting depends on the signal applied to the inverter.

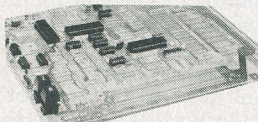
Start learning and computing for only **\$129.95** with a Netronics 8085-based computer kit. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.

THE NEW EXPLORER/85 SYSTEM

Special! Full 8" floppy, 64k system for less than the price of a mini! Only **\$1499.95!**

(Also available wired & tested, \$1799.95)

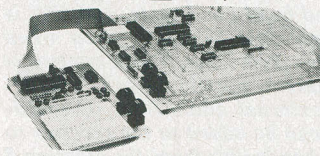
Imagine — for only \$129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers on-board S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only \$129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.



Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. \$129.95



Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)



Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O ... all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

PC Board: Glass epoxy, plated through holes with solder mask. • **I/O:** Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader ... cassette tape recorder input and output ... cassette tape control output ... LED output indicator on SOD (serial output) line ... printer interface (less drivers) ... total of four 8-bit plus one 6-bit I/O ports. • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt ... additional provisions for RST 5.5, 6.5 and TRAP interrupts on-board. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems ... RAM expandable to 64K via S-100 bus or 4k on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F700, leaving 0000 free for user RAM/ROM. Features include tape load with labeling ... examine/change contents of memory ... insert data ... warm start ... examine and change all registers ... single step with register display at each break point, a debugging/training feature ... go to execution address ... move blocks of memory from one location to another ... fill blocks of memory with a constant ... display blocks of memory ... automatic baud rate selection to 9600 baud ... variable display line length control (1-255 characters/line) ... channelized I/O monitor routine with 8-bit parallel output for high-speed printer ... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Keypad/Display Version): Tape load with labeling ... tape dump with labeling ... examine/change contents of memory ... insert data ... warm start ... examine and change all registers ...

single step with register display at each break point ... go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

HEX KEYPAD/DISPLAY SPECIFICATIONS

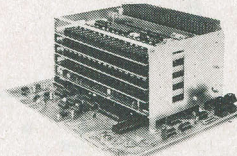
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for on-board 4k RAM expansion selectable in 4k blocks ... address decoding for on-board 8k EPROM expansion selectable in 8k blocks ... address and data bus drivers for on-board expansion ... wait state generator (jumper selectable), to allow the use of slower memories ... two separate 5 volt regulators.

LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.



Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the origi-

nal 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of on-board RAM).

DISK DRIVE SPECIFICATIONS

- 8" CONTROL DATA CORP. professional drive.
- LSI controller.
- Write protect.
- Single or double density.
- Data capacity: 401,016 bytes (SD), 802,032 bytes (DD), unformatted.
- Access time: 25ms (one track).

DISK CONTROLLER I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible).
- 2 Serial I/O ports
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

Beginner's Pak (Save \$26.00!) — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price \$199.95), now at SPECIAL PRICE: **\$169.95** plus post. & insur.

Experimenter's Pak II (Save \$53.40!) — Buy Level "A" (Hex Keypad/Display Version) with Hex Keypad/Display, Intel 8085 User Manual, Level "A" Hex Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price \$279.35), all at SPECIAL PRICE: **\$219.95** plus post. & insur.

Special Microsoft BASIC Pak (Save \$103.00!) — Includes Level "A" (Terminal Version), Level "B", Level "D" (4k RAM), Level "E", 8k Microsoft in ROM, Intel 8085 User Manual, Level "A" Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price \$439.70), now yours at SPECIAL PRICE: **\$329.95** plus post. & insur.

ADD A TERMINAL WITH CABINET, GET A FREE RF MODULATOR: Save over \$114 at this SPECIAL PRICE: **\$499.95** plus post. & insur.

Special 8" Disk Edition Explorer/85 (Save over \$104!) — Includes disk-version Level "A", Level "B", two S-100 connectors and brackets, disk controller, 64k RAM, AP-1 5-amp power supply, Explorer/85 deluxe steel cabinet, cabinet fan, 8" SD/DD disk drive from famous CONTROL DATA CORP. (not a hobby brand!), drive cabinet with power supply, and drive cable set-up for two drives. This package includes everything but terminal and printers (see coupon for them). Regular price \$1630.30, all yours in kit at SPECIAL PRICE: **\$1499.95** plus post. & insur. Wired and tested, only **\$1799.95**.

Special! Complete Business Software Pak (Save \$625.00!) — Includes CP/M 2.0, Microsoft BASIC, General Ledger, Accounts Receivable, Accounts Payable, Payroll Package: (regular price \$1325), yours now at SPECIAL PRICE: **\$699.95**.

Please send the items checked below:

- ☐ Explorer/85 Level "A" kit (Terminal Version) ... **\$129.95** plus \$3 post. & insur.
- ☐ Explorer/85 Level "A" kit (Hex Keypad/Display Version) ... **\$129.95** plus \$3 post. & insur.
- ☐ 8k Microsoft BASIC on cassette tape. **\$64.95** postpaid.
- ☐ 8k Microsoft BASIC in ROM kit (requires Levels "B", "D" and "E") ... **\$99.95** plus \$2 post. & insur.
- ☐ Level "B" (S-100) kit ... **\$49.95** plus \$2 post. & insur.
- ☐ Level "C" (S-100 6-card expander) kit ... **\$39.95** plus \$2 post. & insur.
- ☐ Level "D" (4k RAM) kit ... **\$69.95** plus \$2 post. & insur.
- ☐ Level "E" (EPROM/ROM) kit ... **\$5.95** plus 50c p&h.
- ☐ Deluxe Steel Cabinet for Explorer/85 ... **\$49.95** plus \$3 post. & insur.
- ☐ Fan For Cabinet ... **\$15.00** plus \$1.50 post. & insur.
- ☐ ASCII Keyboard/Computer Terminal kit: features a full 128 character set, u&l case; full cursor control; 75 ohm video output; convertible to baudout output; selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator). ... **\$149.95** plus \$3.00 post. & insur.
- ☐ Deluxe Steel Cabinet for ASCII keyboard/terminal ... **\$19.95** plus \$2.50 post. & insur.
- ☐ New! Terminal/Monitor: (See photo) Same features as above, except 12" monitor with keyboard and terminal is in deluxe single cabinet; kit ... **\$399.95** plus \$7 post. & insur.
- ☐ Hazeltine terminals: Our prices too low to quote — **CALL US**
- ☐ Lear-Sigler terminals/printers: Our prices too low to quote: **CALL US**
- ☐ Hex Keypad/Display kit ... **\$69.95** plus \$2 post. & insur.

- ☐ AP-1 Power Supply Kit ±8V @ 5 amps) in deluxe steel cabinet ... **\$39.95** plus \$2 post. & insur.
- ☐ Gold Plated S-100 Bus Connectors ... **\$4.85** each, postpaid.
- ☐ RF Modulator kit (allows you to use your TV set as a monitor) ... **\$8.95** postpaid.
- ☐ 16k RAM kit (S-100 board expands to 64k) ... **\$199.95** plus \$2 post. & insur.
- ☐ 32k RAM kit ... **\$299.95** plus \$2 post. & insur.
- ☐ 48k RAM kit ... **\$399.95** plus \$2 post. & insur.
- ☐ 64k RAM kit ... **\$499.95** plus \$2 post. & insur.
- ☐ 16k RAM Expansion kit (to expand any of the above in 16k blocks up to 64k) ... **\$99.95** plus \$2 post. & insur, each.
- ☐ Intel 8085 cpu Users' Manual ... **\$7.50** postpaid.
- ☐ 12" Video Monitor (10MHz bandwidth) ... **\$139.95** plus \$5 post. & insur.
- ☐ Beginner's Pak (see above) **\$169.95** plus \$4 post. & insur.
- ☐ Experimenter's Pak (see above) **\$219.95** plus \$6 post. & insur.
- ☐ Special Microsoft BASIC Pak Without Terminal (see above) ... **\$329.95** plus \$7 post. & insur.
- ☐ Same as above, plus ASCII Keyboard Terminal With Cabinet, Get Free RF Modulator (see above) ... **\$499.95** plus \$10 post. & insur.
- ☐ Special 8" Disk Edition Explorer/85 (see above) ... **\$1499.95** plus \$26 post. & insur.
- ☐ Wired & Tested ... **\$1799.95** plus \$26 post. & insur.
- ☐ Extra 8" CDC Floppy Drives ... **\$499.95** plus \$12 post. & insur.
- ☐ Cabinet & Power Supply For Drive ... **\$69.95** plus \$3 post. & insur.
- ☐ Drive Cable Set-up For Two Drives ... **\$25** plus \$1.50 post. & insur.

- ☐ Disk Controller Board With I/O Ports ... **\$199.95** plus \$2 post. & insur.
- ☐ Special! Complete Business Software Pak (see above) ... **\$699.95** postpaid.
- ☐ SOLD SEPARATELY:
 - ☐ CP/M 1.4 ... **\$100** postpaid.
 - ☐ CP/M 2.0 ... **\$150** postpaid.
 - ☐ Microsoft BASIC ... **\$325** postpaid.
 - ☐ Intel 8085 cpu User Manual ... **\$7.50** postpaid.
 - ☐ Level "A" Monitor Source Listing ... **\$25** postpaid.

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE: 800-243-7428

To Order From Connecticut Or For Technical Assistance, Call (203) 354-9375

Total Enclosed (Conn res. add sales tax) \$ _____
 Paid By: _____
☐ Personal Check ☐ Cashier's Check/Money Order
☐ VISA ☐ Master Charge (Bank No. _____)
 Acct. No. _____ Exp. Date _____
 Signature _____
 Print _____
 Name _____
 Address _____
 City _____
 State _____ Zip _____

NETRONICS Research & Development Ltd.
 333 Litchfield Road, New Milford, CT 06776

"RATED NO. 1 FOR SERVICE & RELIABILITY" **THIS MONTH'S SUPER SPECIALS!** **CAR STEREO**

PIONEER CASSETTE IN-DASH W/RADIO	
KP-1500	89.90
KP-2500	104.90
KP-4500	119.90
KP-5500	127.90
KP-8500	142.90
KE-2100	174.90
KE-3000	209.90
KE-5000	244.90
KP-3500 (foreign cars)	129.90
KP-4502 (foreign cars)	144.90
KP-8000 (foreign cars)	154.90
KE-2002 (foreign cars)	209.90
KPX-9000 (requires amp)	154.90
KPX-9500 (requires amp)	179.90
CASSETTE UNDERDASH	
KP-272	69.90
KP-373	84.90
KP-575	94.90
KP-250	104.90
KP-500	129.90
KP-66G (requires amp)	79.90
KP-77G (requires amp)	104.90
KP-88G (requires amp)	99.90
KPX-600 (requires amp)	124.90
KP-707G (requires amp)	144.90
CAR SPEAKERS	
TS-M2	28.90/pr.
TS-13	34.90/pr.
TS-121	34.90/pr.
TS-107	37.90/pr.
TS-167	49.90/pr.
TS-168	44.90/pr.
TS-411	47.90/pr.
TS-695	89.90/pr.
TS-X6	69.90/pr.
TS-X9	129.90/pr.
POWER AMPS/EQUALIZERS	
BP-320 (20 watts/ch.)	54.90
AD-300 (70 watts/ch.)	119.90
AD-30 (30 watts/ch. equalizer)	89.90
AD-50 (50 watts/ch. equalizer)	144.90

PIONEER continued	
GM-12 (6 watts/ch.)	28.90
GM-40 (20 watts/ch.)	49.90
GM-120 (60 watts/ch.)	109.90
CD-5 (7-17 band equalizer)	89.90
CD-7 (7-17 band equalizer)	124.90
JENSEN CAR SPEAKERS	
J1001 (6x9 separates)	94.50/pr.
J1065 (6x9 max. 50 watts)	62.50/pr.
J1033 (6x9 max. 100w)	79.50/pr.
J1101 (4x10 max. 45watts)	62.50/pr.
J1130 (4x10 max. 50 w.)	79.50/pr.
J1174 (5 1/4 max. 50 watts)	62.50/pr.
J1124 (5 1/4 max. 75 watts)	79.50/pr.
J1069 (6x9 coax. 45 watts)	40.50/pr.
J1037 (6x9 coax. 90 w.)	59.90/pr.
J1077 (5 1/4 coax. 45 watts)	41.50/pr.
J1041 (5 1/4 coax. 75 watts)	49.50/pr.
SANYO CASSETTE IN-DASH W/RADIO	
FI-1498	139.90
FI-1498	259.90
FI-646	154.90
FI-646	164.90
FI-1495	169.90
FI-2	54.90
FI-4	64.90
FI-6	71.90
FI-8	99.90
CASSETTE UNDERDASH	
FI-400	74.90
FI-1400	95.90
BLAUPUNKT	
CR2001	229.95
CR2001	269.95
CR3001	469.95
CR3001	559.95

WE ALSO CARRY THE FULL LINE OF CAR STEREO BY: GRUNDIG, MITSUBISHI, CONCORD, PANASONIC, MARANTZ, CLARION, ALPINE, FUSION, AUDIOVOX, CRAIG AND SONY. SEND FOR CATALOG.

BLANK TAPES

CASSETTE TAPES

AMPEX Grand Master I or II C 90	2.99	TDK AD C 60	1.68
BAFSP Pro II or II C 90	2.99	TDK SA C 60	2.45
FLUX 1 or II C 90	2.99	TDK SA C 60	2.15
SCOTCH Low Noise C 90 3pack	5.99	TDK SA C 90	2.99
MEMOREX High Bias C 90	3.79	TDK MA C 60 (metal)	6.29
SONY IXC C 90	3.25	TDK MA C 60 (metal)	7.99
SONY LXC C 90	1.64	MAXELL UD, UDX, I & II C 90	
TDK D C 60	1.19		too low to advertise
TDK D C 90	1.68		call or write for prices

REEL-TO-REEL TAPES

SCOTCH Master (1800 ft.)	5.99	VIDEO TAPES	
SCOTCH 207 (1800 ft.)	5.19	ALL BETA I-500	12.95
MAXELL UD 35-90 (1800 ft.)	5.49	RANTZ CLARION ALPINE, FUSION, AUDIOVOX, CRAIG AND SONY	15.95
TDK L800 (1800 ft.)	5.22	ALL VHS I-120 (except HG)	14.95

VIDEO TAPES

WE CARRY: AMPEX, BASF, FUJI, JVC, MAXELL, PANASONIC, MEMOREX, TDK, SCOTCH, SONY, RCA.

WE ALSO STOCK VIDEO RECORDERS AND HOME VIDEO MOVIES.

MINIMUM ORDER 12 TAPES—100% GUARANTEED

CARTRIDGES

audio-technica	
AT-20 SS	134.90
AT-15 SS	89.95
AT-14 SA	49.95
AT-12 SA	39.95
AT-10	12.95
SHURE	
881 S	79.95
681 EEE-S	59.95
681 EEE	49.95
680 EE	27.95
500 E	14.95
EMPIRE	
2000Z	49.95
2000T	29.95
2000E III	18.50
EDR 9	114.50

ACCESSORIES

DISCWASHER	
COMPLETE SYSTEM	10.95
DISKIT	34.95
DISCORGANIZER	9.95
16 OZ. D3 REFILL	10.95
ZEROSTAT ANTI-STATIC GUN	14.95
SC-1 STYLUS CLEANER	4.95
DISCFOOT	15.95
HEADPHONES	
KOSS pro 4 AAA	46.50
KOSS HV ILC	34.50
KOSS HX ILC	48.50
KOSS HX	42.95
SENNHEISER HD-420	52.50
SENNHEISER HD-430	72.50
AUDIO TECHNICA ATH-7	94.95

RECORDS

ALL ROCK, JAZZ & CLASSICAL

All 7 98 List	\$4.99
All 8 98 List	\$5.49
All 9 98 List	\$5.99

50¢ additional for cassette or 8-track

MINIMUM ORDER: 5 records or tapes

WE STOCK ALL MAJOR LABELS

HOW TO ORDER: For shipment within 48 hours, send money order or certified check. Two weeks delay on personal checks. Please add \$3.50 per order for shipping & handling (\$5.50 for orders outside U.S.). N.Y.S. residents add tax. No C.O.D.'s. All merchandise 100% guaranteed, brand new & factory fresh.

ORDER TOLL FREE (800) 221-8180

ALL OTHER MATTERS: CALL (212) 732-8600

J&R MUSIC WORLD

23 PARK ROW, DEPT. R.T., NEW YORK, N.Y. 10038

CALL OR WRITE FOR FREE 160 PAGE CATALOG

CIRCLE NO. 41 ON FREE INFORMATION CARD

Hobby Scene



By John McVeigh, Technical Editor

Improving Receiver Selectivity

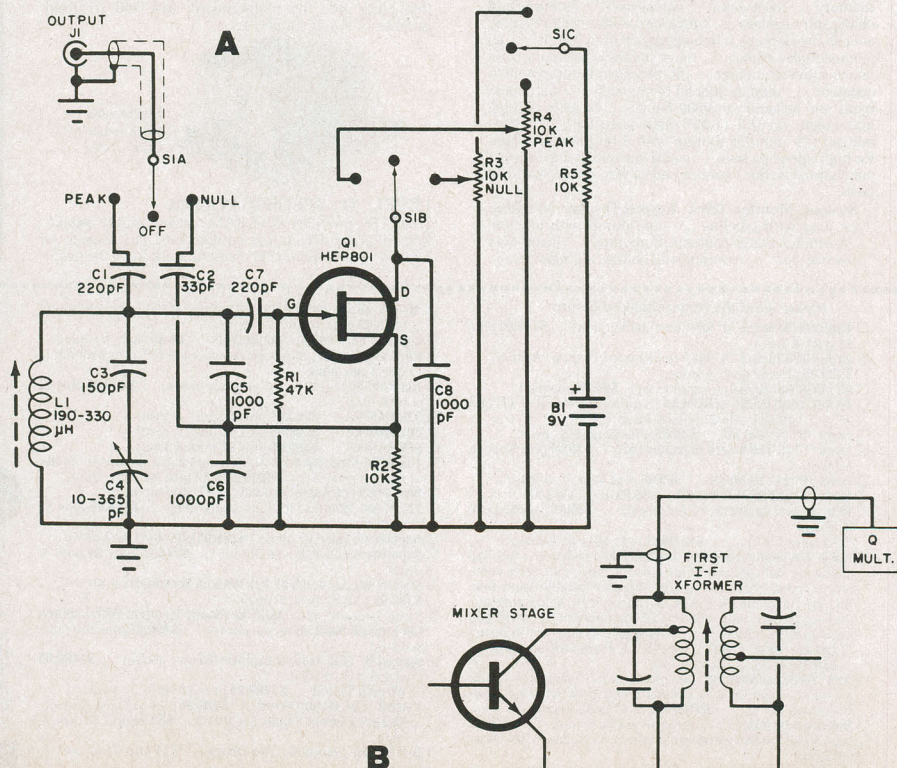
Q. Last November, I purchased a Realistic DX-300 communications receiver. I have found it to be quite adequate in terms of sensitivity and selectivity for the reception of AM broadcast signals. However, the receiver's selectivity is not high enough for reception of SSB signals under crowded band conditions, and CW is almost impossible to copy—even when the receiver's audio bandwidth control is set to its narrow position. Could you describe an external audio filter (Q-multiplier) that can be added to the receiver to narrow its bandwidth from the existing 5 to 6 kHz?—C. F. Baker, Jenison, MI.

A. As the product test report that appeared in the November 1979 issue revealed, the Realistic DX-300 is a fine receiver for AM broadcast listening but isn't up to the critical demands of SSB and CW reception. Part of the problem is that the unit does not (apparently) employ a product detector, and its non-adjustable bfo frequency is too far removed from the suppressed carrier frequency for proper demodulation. Also, as you have noted, it lacks sufficient selectivity.

The first two shortcomings can be dealt with by appropriate internal modifications—the addition of a good prod-

uct detector and a means of varying the beat oscillator's frequency (such as by adding a variable capacitor or a Varactor diode to the bfo's frequency-determining tuned circuit). Insufficient selectivity can be improved by any of several means, some internal modifications and some involving the addition of external devices. For example, replacing the existing i-f filter with a sharper mechanical or crystal filter can yield dramatic improvements. Another approach is to connect a Q-multiplier to the receiver's maximum-selectivity stage (usually the final i-f amplifier). A third method of improving reception of SSB and CW signals is totally external—the insertion of an active audio filter between the audio output of the receiver and the monitor loudspeaker or headphones. Note that the latter two methods are distinct from one another. A Q-multiplier is *not* an audio filter. Rather, it is a regenerative stage that operates at the receiver's intermediate frequency.

Shown in Figure A is the schematic diagram of a Q-multiplier that you can build and use with a receiver having a 455-kHz i-f. It is essentially a 455-kHz Colpitts oscillator that can be adjusted in and out of oscillation by means of potentiometers *R3* and *R4*. When the



Hobby Scene

circuit oscillates, the Q (selectivity) of the tuned circuit comprising *L1* and *C3* through *C6* is determined primarily by the passive components employed. However, when the circuit is adjusted to a regenerative point just short of oscillation, the positive feedback offsets the losses of the passive components. The overall selectivity increases to many times its normal value.

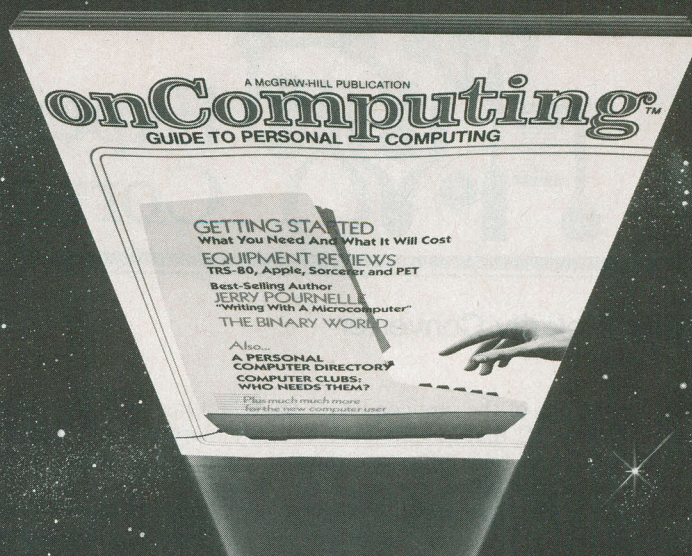
If the circuit is placed in parallel with the receiver's 455-kHz i-f transformer (see Fig. B) and mode switch *S1* is placed in its PEAK position, the receiver's i-f passband can be reduced greatly. Potentiometer *R4* can be adjusted to tune the multiplier and peak any signal in the original passband. Placing *S1* in its NULL position alters the way the Q-multiplier is connected to the i-f transformer and makes it possible to leave the original i-f response unaltered except for the introduction of a sharp notch. This notch is tunable so that unwanted signals can be nulled out.

To use the Q-multiplier, connect it to the receiver using a short length (no more than 24 inches) of coaxial cable. Turn the receiver to a quiet spot on one of the broadcast bands and place *S1* in its PEAK position. Adjust *C4* for mid-capacitance (plates half meshed), place *R4* in its fully clockwise position (maximum resistance above ground), and tune *L1* until you hear a signal. If the Q-multiplier is tuned to the receiver's i-f, the signal will be heard across the band, with a beat note when the receiver is tuned across a transmitted signal. The Q-multiplier can thus be used as a bfo.

Then place *S1* in its NULL position and adjust *C4* until a signal is again heard with *R3* set fully clockwise. (It might be necessary to make a compromise adjustment of *L1* so that the settings of *C4* in the PEAK and NULL modes fall as close to midcapacitance as possible.) Finally, adjust the Q-multiplier so it is just short of oscillating and adjust the receiver's i-f transformer for optimum response.

It takes some practice to learn how to use the Q-multiplier efficiently. Adjusting *R4* more and more clockwise increases selectivity and decreases the i-f bandwidth. Greatest selectivity will occur just before the onset of oscillation, which is indicated by a ringing sound as the receiver is tuned across a signal. In the NULL mode, the notch is made sharper as *R3* is adjusted progressively clockwise. A very noticeable decrease in amplitude will be heard as the notch is centered (by means of *C4*) on an offending signal. Further information on construction and operation of this Q-multiplier can be found in the April 1974 issue of POPULAR ELECTRONICS, in an article by Joe A. Rolf. ♦

Have a problem or question in circuitry, components, parts availability, etc? Send it to the Hobby Scene Editor, POPULAR ELECTRONICS, One Park Ave., New York, N.Y. 10016. Though all letters can't be answered individually, those with wide interest will be published.



When will the Personal Computer Explosion touch YOU?

Are you prepared for the explosive transformation? Right in your own home? Electronic mail. Personalized investment analysis. Foreign language tutorial. Home energy management. Robots. Computer music. Secretarial service. Diet and menu planning. And more, more, more.

onComputing™ the new McGraw-Hill quarterly, prepares you for the enormous

changes coming during the 1980's (Some are already here). **onComputing™** explains in nontechnical language what personal computers are, how they work, and how you can use them at home, for fun and profit.

Don't let the personal computer explosion catch you off guard. Know what's happening and help make it happen! Prepare now for the exciting future with **onComputing™**!

Start your subscription today.
Call Toll Free 800-258-5485

onComputing™ Subscription Dept. P.O. Box 307, Martinsville, NJ 08836

DOMESTIC subscription rate:

☐ U.S. 1 yr. (4 issues) @ \$8.50 ☐ Canada & Mexico, 1 yr. (4 issues) @ \$10.00

FOREIGN (to expedite service, please remit in U.S. funds drawn on a U.S. bank.)

☐ Europe (and all other countries, except above), 1 yr. @ \$12.00 — surface delivery.

☐ Bill Visa ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number

Expiration

Signature

Name (please print)

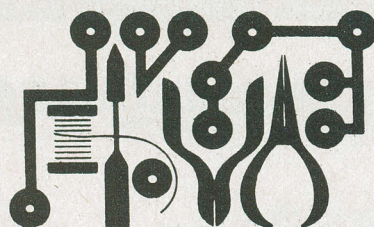
Street/Apartment Number

City

State/Province/Country Code

7391

Please allow 6-8 weeks for processing



Experimenter's Corner

By Forrest M. Mims

An Integrated Polarity Converter

EVERY few years, one of the semiconductor manufacturers introduces a new IC that quickly becomes a standard building block. Three classic examples are the 741 op amp, the 555 timer and the LM109 5-volt regulator. Recently, Intersil introduced its ICL7660 voltage polarity converter, which is sure to become a standard building block IC. The ICL7660 is a useful power-supply chip which generates a negative voltage from a positive input voltage. If you've ever wanted to employ a circuit that required a dual-polarity power supply in an application where only a single-ended supply was available, you can readily appreciate the practical implications of this new chip.

About the ICL7660. A block diagram of the ICL7660 appears in Fig. 1. It shows what might at first seem to be a relatively complex circuit. Actually, the operation of the

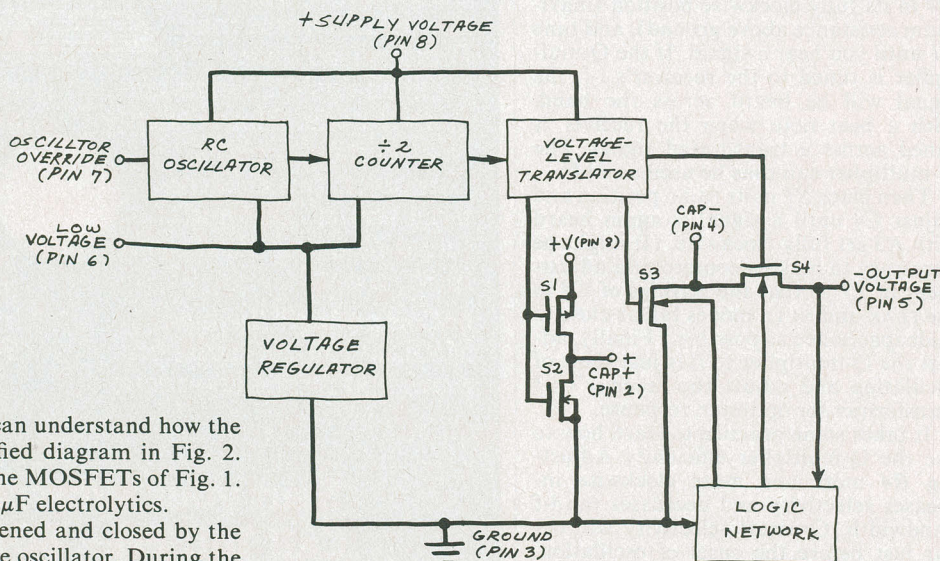
Without this precaution, Intersil reports that high power loss and device latchup (presumably resulting from overheating) would occur.

Using the ICL7660. The pinout diagram of the ICL7660 appears in Fig. 3. The chip can be powered by a supply voltage of +1.5 to +10 volts. It has a typical open-circuit voltage conversion efficiency of 99.9% and a power efficiency of 98%.

The output of the internal voltage regulator can be shorted to ground to improve low-voltage operation. This is accomplished by connecting pin 6, the LV (low-voltage) terminal, to pin 3. Note, however, that if the power-supply voltage is greater than +3.5 volts, the LV pin must *not* be grounded or device latchup might occur.

If the supply voltage exceeds +6.5 volts, a diode (*D1* in Fig. 4) should be connected in series between pin 5, the output

Fig. 1. Block diagram showing how the ICL7660 functions as a voltage polarity converter.



ICL7660 is straightforward, and you can understand how the chip works by referring to the simplified diagram in Fig. 2. Switches *S1* through *S2* in Fig. 2 are the MOSFETs of Fig. 1. Capacitors *C1* and *C2* are external 10- μ F electrolytics.

In operation, *S1* through *S4* are opened and closed by the switch logic at a rate determined by the oscillator. During the first half of the operating cycle, *S1* and *S3* are closed, and *S2* and *S4* are open. This allows *C1* to charge to the positive supply voltage. During the second half of the cycle, *S1* and *S3* are open, and *S2* and *S4* are closed. This inverts the connection of *C1* with respect to ground so that the output voltage is now equal in magnitude to the positive supply voltage but opposite in signal (polarity). The switches also connect *C2* in parallel with *C1*, thus causing *C2* to draw charge from *C1*. This enables *C2* to serve as a reservoir of charge during the first half of the cycle, when *C1* is being charged.

The MOS switches, which occupy most of the ICL7660 chip's real estate, required clever design techniques—although this might not be immediately obvious. The channels of *S3* and *S4* must remain nonconductive to prevent device latchup when power is first applied and when the output is short-circuited. The logic network (Fig. 1) monitors the output voltage, and the voltage-level translator applies bias when necessary to keep both switches (*S3* and *S4*) nonconductive.

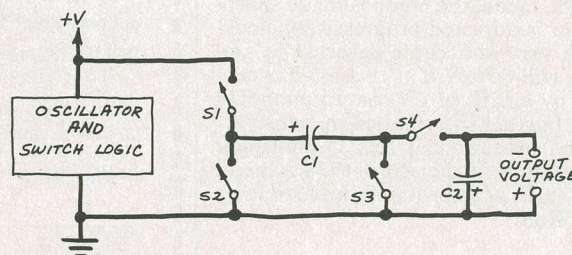


Fig. 2. Simplified version of Fig. 1.

terminal, and the load. Of course, this will reduce the voltage delivered to the load by an amount equal to the diode's voltage drop—about 0.6 volt for a silicon diode and 0.3 volt for a germanium diode. However, the addition of the diode permits the

World's First and Only Solar-Powered Watch*

Guaranteed to outperform any watch sold today... or costs you nothing!

The Sunwatch; acclaimed as the most accurate, most versatile, most rugged watch ever made.

These features make all other watches obsolete:

- Clearly visible by day or night
- Natural side-view window simplifies reading
- 100% solar-powered, you never replace batteries
- No resetting of calendar, not even in leap years

Space age accuracy

Now you'll never worry about accuracy again. Because the Sunwatch will keep you on time for the rest of your life. (Accurate to within 1 sec. per month.)

Solar age efficiency

Miniature solar cells automatically convert sunlight, daylight or ordinary bulb light into usable energy for storage. The solar cells last virtually forever. So you'll never replace a watch battery again.

Programmed for over a century

The built-in computer on a chip will always display the correct time date and month. Also, it automatically adjusts the watch calendar for long and short months, leap years and it's programmed until the year 2100!

Easy to read

The natural side-view display lets you tell the time, day and date without twisting your arm into an uncomfortable position.

Numbers always visible

Four varying light intensities are built into the viewing display, allowing the Sunwatch to adjust automatically to any light. This means you can always read it, even in the brightest sunlight.

10 Display functions

The Sunwatch is capable of displaying the following information: hours • minutes • seconds • months • date • day • leap year • speed calibration • AM/PM indicator • seconds count-off.

Extreme accuracy

Unlike other electronic watches using tuned crystals to control timing accuracy, the Sunwatch incorporates a unique, programmable, microcircuit synthesizer to make it the first watch in history that is accurate to less than 1 second per month. That's 5 times more accurate than the latest quartz Accutron.

The Power Source

Tiny silicon power cells, which are constantly being energized by natural sunlight, daylight or an ordinary light bulb keep the Sunwatch energy storage system charged. Should the watch not be exposed to light, it will continue to operate for months on stored power.

The most indestructible watch in the world
The workings of the watch: solar panels, energy cells, quartz crystal, computer on a chip, etc., are all permanently sealed in a Lexan module. This module is so unique it's protected by U.S. and foreign patents.

Completely waterproof

Leave the Sunwatch in salt water for months. Dive with it in depths up to 750 feet. There are no openings — magnetic slide bars activate all functions. With Sunwatch's exclusive, permanently sealed Lexan module, there are no "O" rings or seals to leak.



Shock resistant to 25,000 G's

You can crash it into a rug-surfaced brick wall at 90 mph with no noticeable effect. Wear it while doing heavy work, exercise or any strenuous activity.

Temperature resistant

Put the Sunwatch in boiling water for 30 minutes, freeze it in a block of ice for a year. Extreme temperatures will not damage your Sunwatch.

Pressure resistant

There are no air spaces inside the Sunwatch. Therefore, it is not susceptible to high pressures such as might be encountered diving to great depths.

The perfect watch for a lifetime

Imagine split-second accuracy for the rest of your life. Sunwatch is a virtually indestructible, beautifully styled, space-age timepiece, and it's available in three exciting finishes: Brushed stainless steel, Gold tone stainless steel, or a Durable black finish on stainless steel. All Sunwatches come with a matching stainless steel band with removable links and adjustable clasp.

Made in the United States

The Sunwatch, designed by Roger Riehl, was being worn by its inventor nearly a year before the first electronic digital watch was even available to the general public. Since that time constant engineering evaluations and design improvements have been made on the Sunwatch to incorporate the latest in digital microcircuit and solar power technology. Thus the Sunwatch today represents state-of-the-art electronics technology. It is built to the same rigid standards practiced by the manufacturer in creating sophisticated computer microcircuits for the U.S. Government and other major users of these components.

* A word about other "Solar Watches"

Roger Riehl, designer of the Sunwatch, states that there is no other completely solar powered watch on the market today. Claims of solar power by other watch manufacturers are based on the use of a small solar cell. Due to their limited size, these cells can be proven, in technical terms, to be of virtually no significant value in extending the life of a watch battery. For this reason, all other so-called "solar watches" must have replaceable batteries. The Sunwatch's power storage system, however, need never be changed and is, in fact, permanently sealed to withstand abuse and the elements.

Unique and memorable gift

Available in a special gift box (see order form) the Sunwatch makes an ideal gift for special holidays, birthdays, graduation, Father's Day, etc. Perfect for business people, commuters, teachers, athletes and sportsmen, who require split second accuracy

Free custom engraving

At your request, each Sunwatch will be hand-engraved with the name you specify.

Limited Warranty is your protection

The Sunwatch is covered by a 2 year limited warranty issued by Riehl Time Corporation (manufacturers of the prestigious Synchronar 2100) and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Riehl Time Corp., 53 S. Jefferson Rd., Whippany, NJ 07981. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

15 Day no risk trial offer

Order your Sunwatch today and use it for 15 days. Then, if you are not completely satisfied return it for full money back.

CREDIT CARD ORDERS CALL TOLL FREE 800-621-5199

Ill. Residents Call 800-972-5855

OR MAIL THIS NO RISK COUPON

RIEHL TIME CORP.

53 S. Jefferson Rd., Dept. 44A Whippany, NJ 07981.

Please send me:

- _____ Brushed Stainless Steel Sunwatches at \$129.95 each
- _____ Black Finish on Stainless Steel Sunwatches at \$159.95 each.
- _____ Gold Tone Stainless Steel Case Sunwatches at \$159.95 each.
- _____ 24 Hour (Military Time) \$10.00 Additional.
- _____ Gift Boxes at \$4.95 each.

Please add \$3.95 per watch shipping and insurance.

Enclosed is \$_____ Check or Money Order

(N.J. Residents add appropriate sales tax)

CHARGE IT! (Check One)

☐ Master Charge ☐ VISA (BankAmericard)

Credit Card# _____ Bank# _____

Issue Date _____ Exp. Date _____

Signature _____

Name to be engraved _____

Name _____

Address _____

City/State/Zip _____

Quick delivery direct from the manufacturer

CIRCLE NO. 65 ON FREE INFORMATION CARD

Experimenter's Corner

chip to operate over its entire rated temperature range at a supply voltage with a maximum of 10 volts without the possibility of device latchup.

The oscillator frequency of the ICL7660 is typically 10 kHz. If this frequency of oscillation causes interference to circuits powered by or close to the ICL7660, it can be changed. To lower the frequency of the oscillator, connect a capacitor ($C3$) between pins 7 and 8. The installation of a 100-pF capacitor will lower the frequency from 10 kHz to 1 kHz. This reduction in frequency must be accompanied by an increase in the capacitance of $C1$ and $C2$ by the same factor the frequency is reduced. Because 1 kHz is one-tenth of 10 kHz, $C1$ and $C2$ must be increased by a factor of ten (to 100 μ F).

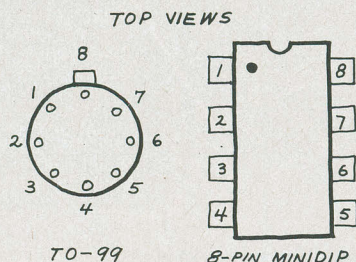


Fig. 3. Pin outlines of the ICL7660.

PIN 1—NO CONNECTION (NC)
PIN 2—CAPACITOR + (CAP +)
PIN 3—GROUND (GND)
PIN 4—CAPACITOR— (CAP—)
PIN 5—OUTPUT VOLTAGE (V_{OUT})
PIN 6—LOW VOLTAGE (LV)
PIN 7—OSCILLATOR (OSC)
PIN 8—SUPPLY VOLTAGE (V_S)

The frequency of oscillation can be increased by overdriving the internal oscillator with an external clock or oscillator. In this case, however, the values of $C1$ and $C2$ need not be reduced. Figure 5 shows how to connect CMOS or TTL circuits to the OSCILLATOR OVERRIDE input (pin 7) of the ICL7660.

Finally, keep in mind that the ICL7660 is a CMOS chip. Standard CMOS handling precautions should be observed. Don't use an ungrounded soldering iron. Also, be sure to protect the chip from static voltages when installing it.

Applications. The ICL7660 is a brand new chip, so it might not yet be available from parts suppliers who advertise in POPULAR ELECTRONICS. If not, contact an Intersil sales office or an Intersil distributor. (Distributors are listed in the Yellow Pages under "Electronic Equipment and Supplies.") Don't attempt to order chips directly from Intersil because the company cannot process retail orders. The ICL7660 sells for \$1.95 in lots of 100, so you will have to expect to pay more for single quantities.

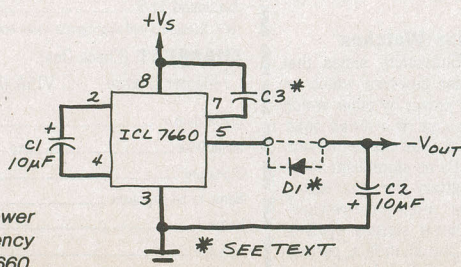


Fig. 4. How to lower the oscillator frequency of the ICL7660.

The circuits which follow will give you some ideas about how to use the ICL7660 in specific applications. The chip is so easy to use that you should have few, if any, problems when you try the circuits on your own.

Basic Polarity Converter. Figure 6 shows a simple voltage-polarity converter employing a single ICL7660. The circuit has two design variations which are dependent upon the magnitude of the supply voltage. When $+V_S$ is less than 3.5 volts,

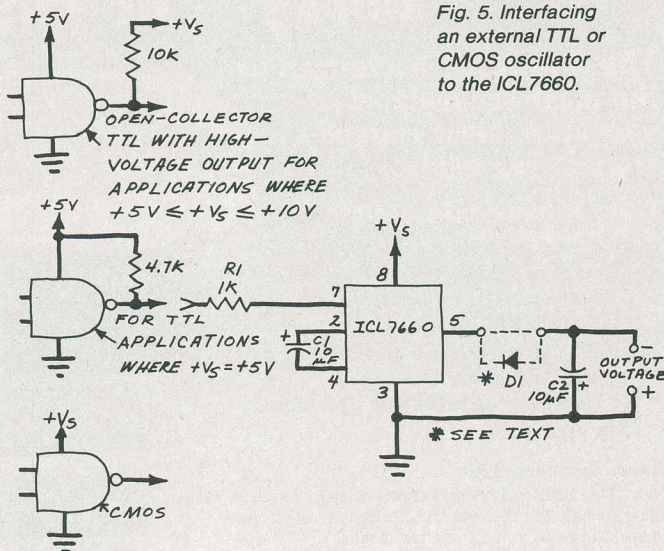


Fig. 5. Interfacing an external TTL or CMOS oscillator to the ICL7660.

pin 6 should be grounded. When the supply voltage is greater than +6.5 volts, $D1$ should be connected to pin 5 as shown. In no case should any pin be connected to a voltage higher than the supply voltage or below circuit ground. Otherwise, the chip might be destroyed.

Voltage Multiplication. Figure 7 shows how to cascade two ICL7660's to double the negative voltage available from a single chip. When the supply voltage exceeds +6.5 volts, $D1$ and $D2$ must be included. This will reduce the output voltage by the sum of the voltage drops across each diode. Thus, when a 10-volt supply is used and both $D1$ and $D2$ are silicon diodes, the voltage out will be -18.8 volts.

You can cascade up to ten ICL7660's using the cascade configuration shown in Fig. 7. Assuming that the $+V_S$ terminal of the first ICL7660 is connected to a +10-volt supply and that a silicon diode is connected in series with each IC's output terminal, the output voltage at the end of the multiplier string will be -94 volts!

Until now, all of the circuits we have described have had outputs whose polarity has been inverted with respect to the power supply (a positive supply voltage and a negative output voltage). The next circuit to be shown is a voltage multiplier whose output is of the same polarity as the supply. The circuit shown in Fig. 8 provides positive voltage multiplication using a single ICL7660. Capacitor $C1$ charges to the supply voltage less the voltage drop across $D1$. The sum of the voltage across

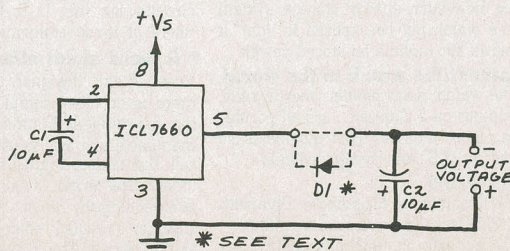


Fig. 6. Ultra-simple voltage polarity converter.

$C1$ and the supply voltage then charges $C2$ through $D2$. The resulting output voltage is twice the supply voltage less the sum of voltage drops across the two diodes.

Dual-Output Supply. The circuit shown in Fig. 9 performs positive voltage multiplication and negative voltage conversion using a single ICL7660. This configuration can provide

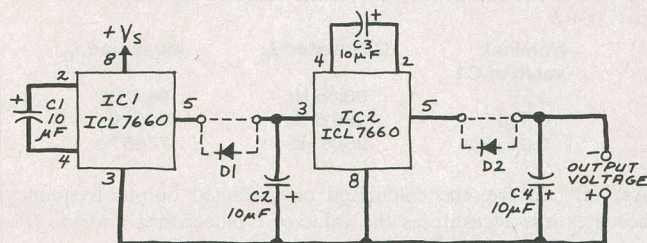


Fig. 7. Negative voltage multiplication by cascading ICL7660s.

several different combinations of output voltage from a single positive supply. The voltage level appearing across the negative output is an inverted version of the positive supply voltage (less one diode drop if the supply voltage exceeds 6.5 volts, in which case $D1$ must be included). The voltage level across the positive output is twice the positive supply voltage less the sum of two diode drops with *no* polarity inversion.

The high efficiency of the ICL7660 is apparent from an inspection of the following table. It is a list of output voltages that I measured when a sample chip was powered with a given sequence of positive supply voltages.

$+V_S$	Negative Output	Positive Output
+1.5	-1.5 V	+ 1.8 V
+3.0	-3.0 V	+ 4.2 V
+5.0	-5.0 V	+ 8.8 V
+6.0	-6.0 V	+10.8 V
+9.0	-8.4 V	+16.8 V
+10.0	-9.4 V	+18.8 V

Note that the voltage drops across $D2$ and $D3$ prevent the positive output level from approaching twice the positive supply voltage, especially at low supply voltages. Also, $D1$ was included when $+V_S$ was raised above +6.5 volts, so the negative output levels measured when $+V_S$ was +9 and +10 volts reflect the forward voltage drop across the diode. This circuit can be made more versatile by adding one or more ICL7660s to multiply the negative output voltage level.

Square-Wave Oscillator. The ICL7660 is ideally suited for supplying the negative voltage to op-amp circuits that require a bipolar supply. Such a circuit is the square-wave oscillator appearing in Fig. 10. The circuit provides a true ac square wave that is *not* riding on a dc level. It can be powered by a single-ended 5-volt supply or a 9-volt battery.

The component values shown result in a square-wave frequency of approximately 900 Hz. Changing the values of $R1$, $C1$ or both $R1$ and $C1$ will change the frequency of oscillation. More precisely, the frequency equals the reciprocal of the product of $(2R1C1)$ and the natural logarithm of the quantity $(2R2/R3 + 1)$.

The value of resistor $R2$ should be approximately one-third

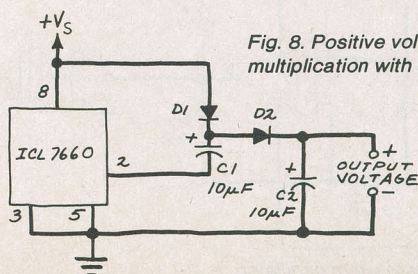


Fig. 8. Positive voltage multiplication with single ICL7660.

HOME STUDY COURSE ON CASSETTE



Each course below includes a special course book plus two cassettes, for a total course length of 2 1/2 hours. The lecture is completely coordinated to the pages of the book, and cassettes can be played on any standard cassette player.

S1-INTRODUCTION TO MICROPROCESSORS

For Non-Specialists. Course contains: Definitions•Application•Evaluation Terms•System Components•2.5 hrs.

\$2995

S2-PROGRAMMING MICROPROCESSORS

For the student who has completed S1. GOAL: To provide an overall and practical understanding of the concepts of Micro Computer Programming. 2.5 hours.

\$2995

• NO TECHNICAL BACKGROUND ASSUMED •



EPROM'S

2708	\$6.75
1K x 8 450NS	
8 FOR \$48.50	
2716	\$18.95
16K (2K x 8) 450NS	
8 FOR \$142.95	
2732	\$59.50
32K (4096 x 8)	
	\$58.50

74LS00	.38	74LS27	.36	74LS138	.85
74LS02	.34	74LS30	.26	74LS151	.75
74LS03	.34	74LS32	.39	74LS153	.75
74LS04	.38	74LS38	.39	74LS155	1.15
74LS08	.35	74LS42	.78	74LS158	.75
74LS09	.38	74LS48	.78	74LS160	.95
74LS10	.28	74LS51	.25	74LS161	1.10
74LS11	.45	74LS54	.35	74LS162	.95
74LS12	.38	74LS74	.52	74LS163	.95
74LS13	.38	74LS75	.65	74LS164	1.15
74LS14	.39	74LS83	.95	74LS165	.89
74LS15	1.15	74LS170	1.95		
74LS16	.45	74LS174	.90		
74LS17	.70	74LS175	.90		
74LS18	.70	74LS221	1.40		
74LS19	.45	74LS240	2.45		
74LS20	.48	74LS241	2.45		
74LS21	.48	74LS243	2.20		
74LS22	.50	74LS244	2.45		
74LS23	1.15	74LS245	2.50		
74LS24	.86	74LS374			



CONCORD COMPUTER COMPONENTS

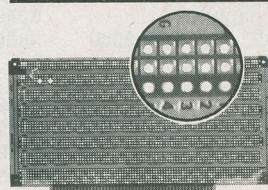
1971 SOUTH STATE COLLEGE ANAHEIM, CA. 92806
(714) 937-0637

2114L (1K x 4) (Static RAM) \$450 EA

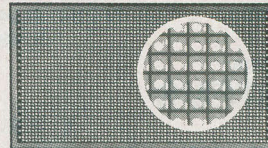
4116 (16K x 1) (Dynamic RAM) \$4750

CIRCLE NO. 17 ON FREE INFORMATION CARD

WIRE UP MICROPROCESSORS & DIP CIRCUITS FASTER USE VECTOR PROFESSIONAL BREADBOARDING PRODUCTS



8804



45P80-1

FREE 12 PAGE CATALOG See us at WESCON Booth No. 114-16

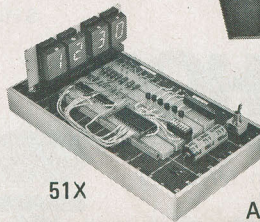
\$100 Plugboards - 5 models plus
12 other Plugboards for all popular buses.

New pad-per-hole Micro-Vector-board® wiring board. 96 Vector-boards available.



P184-4T

Reliable Slit-N-Wrap wire wrapping tools and terminals.



51X

Solderless Breadboards - One model handles standard or wide DIP packages with plenty of solderless tie points.

Ask your favorite electronics supplier.



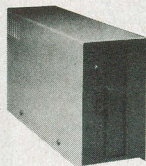
77805

Vector Electronic Company
INCORPORATED

12460 Gladstone Ave., Sylmar, CA 91342

CIRCLE NO. 76 ON FREE INFORMATION CARD

WE WILL NOT BE UNDERSOLD



DISK DRIVES

\$314

More capacity than Radio Shack 35 Track (80 K Bytes) drives. Fully assembled and tested. Ready to plug-in and run the moment you receive it. Can be intermixed with each other and Radio Shack drive on same cable. TRS-80* compatible silver enclosure. External card edge included.

90 DAY WARRANTY. ONE YEAR ON POWER SUPPLY.

FOR TRS-80*

CCI-100	5 1/4", 40 Track (102K Bytes) for Model I	\$314
CCI-200	5 1/4", 77 Track (197K Bytes) for Model I	\$549
CCI-800	8" Drive for Model II (1/2 Meg Bytes)	\$795

For Zenith Z89

CCI-189	5 1/4", 40 Track (102K Bytes) add-on drive	\$394
Z-87	Dual 5 1/4" add-on drive system	\$995

DISKETTES — Box of 10 (5 1/4") — with plastic library case **\$24.95**
8" double density for Model II (box of 10) **\$36.49**

16K MEMORY UPGRADE KITS **\$49**

for TRS-80*, Apple II, (specify): Jumpers **\$2.50**

PRINTERS

NEC Spinwriter

Letter Quality High Speed Printer

Includes TRS-80* interface software, quick change print fonts, 55 cps, bidirectional, high resolution plotting, graphing, proportional spacing: R.O. **\$2689**

R.O. with Tractor Feed **\$2789** KSR with Tractor Feed **\$3200**

779 CENTRONICS TRACTOR FEED PRINTER **\$969**

Same as Radio Shack line printer I

737 CENTRONICS FRICTION & PIN FEED PRINTER **\$839**

9 x 7 matrix

730 CENTRONICS FRICTION & PIN FEED PRINTER **\$639**

7 x 7 matrix Same as Radio Shack line printer II

P1 CENTRONICS PRINTER **\$269**

Same as Radio Shack quick printer

PAPER TIGER (IP440) **\$939**

Includes 2K buffer and graphics option

TI-810 Faster than Radio Shack line printer III **\$1575**

Parallel and serial w/TRS-80* interface software

with upper and lower case and paper tray **\$1665**

OKIDATA Microline 80 Friction and pin feed **\$559**

Tractor Feed, friction, and pin feed

EATON LRC 7000 + 64 columns, plain paper **\$679**

ANADIX DP-9500 **\$1389** **DP-8000** **\$869**

COMPLETE SYSTEMS

TRS-80* LEVEL II-16K with keypad **\$709**

TRS-80* Expansion Interface **\$269**

HEWLETT PACKARD HP-85 **\$3199**

ZENITH Z89, 48K all-in-one computer **\$2595**

ZENITH Z19 **\$740**

TELEVIDEO **912B** **\$745** **920B** **\$769**

ATARI 400 **\$489** **ATARI 800** **\$799** **TI 99/4** **\$894**

MATTEL INTELLIVISION **\$249**

Software available for the above systems

DISK OPERATING SYSTEMS

PATCHPAK #4 by Percom Data **\$ 8.95**

CP/M for Model I, Zenith **\$145** • for Model II, Altos **\$169.00**

NEWDOS Plus — with over 200 modifications 35track **\$ 89.00**

and corrections to TRS-DOS 40 or 70 Track **\$ 99.00**

CAT MODEM Originate and answer same as **\$148**

Radio Shack Telephone Interface II

LEEDEX MONITOR Video 100 **\$119**

The CPU SHOP

TO ORDER CALL TOLL FREE 1-800-343-6522

5 Dexter Row, Dept. PE-9M, Charlestown, MA 02129

Hours: 10AM-6PM (EST) M-F (Sat. till 5)

Mass. Residents: Call 617/242-3361, add 5% sales tax

*TRS-80 is a Tandy Corp. T.M. • Prices subject to change

DEALER (NATIONAL/INTERNATIONAL) INQUIRIES INVITED



Experimenter's Corner

that of $R1$. The resistance of $R3$ should be from two to ten times that of $R2$. For those readers who lack access to scientific calculators or sophisticated slide rules, the component values specified in Fig. 10 cause the expression $\ln(2R2/R3 + 1)$ to equal 0.5068. Therefore, the frequency of oscillation equals $1/(10,136)(C1)$.

Here are some results that I obtained using a breadboarded version of the circuit where f_o is the output frequency:

Nominal value of C1	Calculated f_o	Measured f_o
1 μF	98.65 Hz	95.8 Hz
0.1 μF	986.5 Hz	908 Hz
0.01 μF	9865 Hz	7768 Hz

As you can see, the calculated or predicted output frequency becomes less accurate as the value of $C1$ decreases and the frequency of oscillation increases.

I originally built this circuit as part of an experimental high-voltage power supply. Connecting the secondary of a 6.3-volt fila-

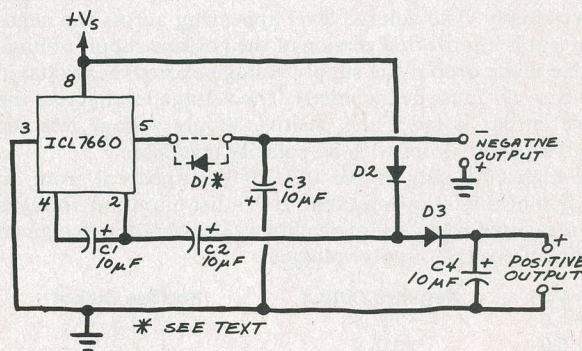


Fig. 9. Combined positive and negative voltage multiplication.

ment transformer between pin 6 of the 741 and ground will cause 80 volts of ac to appear across the transformer's primary when the circuit is powered by a +6-volt supply. Increasing the supply voltage to +9 volts will boost the voltage induced across the primary of the transformer output to 160 volts ac. You can connect a diode-capacitor voltage multiplier to the output of the transformer to obtain even higher dc voltages.

Use caution if you add the transformer (and possibly a voltage multiplier) to the oscillator shown in Fig. 10. Such a combination can deliver a hefty shock!

Going Further. The ICL7660 is intended primarily for use in microprocessor, controller and data-acquisition systems which have a +5-volt supply for the digital circuits and require a negative voltage for analog stages. It's also ideal for providing -5-volt body bias for dynamic RAMs. Perhaps the basic circuits described in this column will give you some ideas for many other applications. ◇

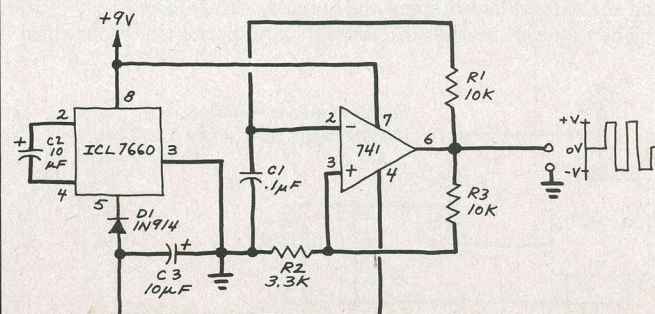
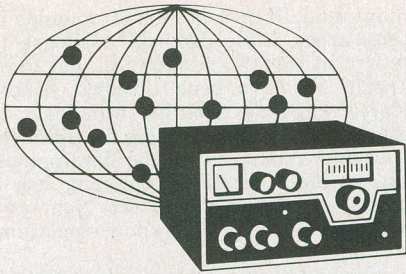


Fig. 10. Circuit for a square-wave oscillator.



DX Listening

By Glenn Hauser

USAF Starts Radar on Shortwave Broadcast Bands

SHORTWAVE listeners, already plagued by U.S. military tactical communications, radioteletype, jamming, the "Russian woodpecker" and interference among SWBC stations themselves, which are crammed into about one third of the spectrum they need, now are faced by a new threat. The United States Air Force has decided that its Over-The-Horizon Backscatter (OTHB) radar system will transmit on the bands supposedly reserved worldwide for nothing but international broadcasting.

This plan is explained in some detail in the April 1980 issue of *QST*. Hams are naturally pleased that the USAF OTHB radar system has decided not to operate on amateur bands; any interference there should be only incidental and is to be handled by a "good-neighbor policy." Also excluded are portions of the shortwave spectrum between 6.8 and 22 MHz, which are allocated to aeronautical and maritime communications, and standard frequencies. This leaves only those bands designated as "fixed" (point-to-point) and broadcasting.

Without a doubt there are many times more shortwave listeners than there are amateurs. Unfortunately, we are not as well organized as the hams, nor do we have a powerful lobby looking out for our interests like the hams' ARRL. Consequently, SW listening is easier to step on.

Though the OTHB radar system does need access to a wide range of frequencies, no evidence has been presented that it is essential for it to use both the fixed bands—where it obviously belongs as a "utility" service—and the broadcast bands, where it obviously does not belong and can only cause harmful interference to shortwave programming.

Indeed, it is easy to make the case that, if OTHB needs more spectrum than the fixed bands can provide, it should be allowed in the ham bands rather than broadcast bands. The amateur bands are already occupied by non-voice signals, such as radioteletype, CW, slow-scan television, facsimile, etc. Hams have the great advantage of being able to change frequency on short notice to avoid interference, while SWLs have to put up with whatever nonbroadcast

garbage is interfering with frequencies that can be changed only on a delayed and long-term basis. Furthermore, amateur radio has always been the place for experimentation in new uses of radio, which this certainly is.

There is some hope, though. The USAF OTHB system is allegedly not as disruptive as the 10-per-second millisecond-length pulses coming from the Soviet equivalent, which has been disrupting all shortwave bands for several years. The USAF supposedly uses a narrower bandwidth and automatically selects a "clear" frequency. (This is done for its own effectiveness, and not as a consideration for other users of the spectrum). But a frequency that's "clear" to the OTHB receiving site may be just the frequency on which a listener elsewhere is trying to hear a weak signal.

The sound of the USAF OTHB radar is quite different from the "Soviet woodpecker." The USAF OTHB is described as sounding on an AM receiver like powerline hum at any of several modulation frequencies from 20 to 60 Hz. It is extremely important not to confuse the two. We do not have any say about what the USSR does; we do in the U.S.

The military organization controlling the OTHB system in Maine (with another one to be activated on the West Coast), evidently cares nothing about interference to shortwave listeners. It has, however, invited amateurs experiencing interference to file complaints and has set up an address for this.

To get our views across too, I urge shortwave listeners not only to complain about every instance of interference actually observed, but to complain now against the idea that OTHB should be allowed in the SWBC bands at all. The address is: OTH Radar Office, USAF Electronic Systems Division, Code OCUE, Hanscom AFB, MA 01731. Also send copies to your congressman, senators and the FCC. Let the authorities know we indeed care enough to protect our shortwave broadcasting bands!

Third-Language Services. Most countries involved in international broadcasting transmit in English to North America, for obvious reasons. They also beam programs here in their

OUR PRICES ARE TOO LOW TO ADVERTISE!

CHECK THEM—CALL TOLL FREE!

800-243-7428

LOOK WHAT WE OFFER!

- **HAZELTINE**
Terminals
- **CENTRONICS**
Printers
- **LEAR-SIEGLER**
Terminals/Printers
- **DATAPRODUCTS**
Printers
- **ANNADEX**
Printers

BE SMART- DON'T BUY UNTIL YOU CHECK OUR PRICES!

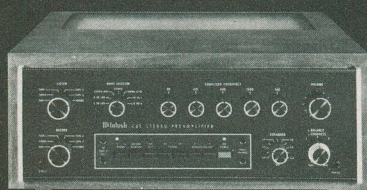
☐ MASTERCHARGE
☐ VISA ☐ COD
☐ PERSONAL CHECK
☐ MONEY ORDER

NETRONICS

RESEARCH & DEVELOPMENT, LTD.
333 Litchfield Rd., New Milford, CT 06776

McIntosh

"A Technological Masterpiece..."



McIntosh C 32

"More Than a Preamplifier"

McIntosh has received peerless acclaim from prominent product testing laboratories and outstanding international recognition! You can learn why the "more than a preamplifier" C 32 has been selected for these unique honors.

Send us your name and address and we'll send you the complete product reviews and data on all McIntosh products, copies of the international awards, and a North American FM directory. You will understand why McIntosh product research and development always has the appearance and technological look to the future.

Keep up to date.
Send now - - -

McIntosh Laboratory Inc.
Box 96 East Side Station
Binghamton, NY 13904

Name

Address

City State Zip

If you are in a hurry for your catalog please send the coupon to McIntosh. For non-rush service send the Reader Service Card to the magazine.

CIRCLE NO. 50 ON FREE INFORMATION CARD

DXL continued

native language, which also makes sense (a few diehards, such as Denmark and France, broadcast to us *only* in their native language—this is easier to sell in the home country on the grounds that it will reach expatriates or emigrants rather than foreigners). Spanish and French are also legitimately targeted on North America, since they are widely understood in portions of this continent.

But there are some oddball broadcasts which are in other languages neither native to the country of origin, nor understood by more than a tiny fraction of the SWL audience.

Russian is a good example; until May of this year, Israel beamed it toward New York every night at 0300 GMT. It was dropped due to budget problems. Since the difficulties in Iran, Israel has stepped up its broadcasts in Persian, but also beamed one of the broadcasts to the U.S.—1530-1625 GMT on 21675 kHz. It should be noted that both these transmissions involve simulcasting programs to the more obvious destinations.

HCJB, Ecuador, is another station with Russian to North America, at 0130-0200 GMT on 11810 (frequently changed). However, HCJB is well aware that part of the USSR lies just beyond North America from the viewpoint of Ecuador. HCJB also broadcasts in Russian to Australia and in German and Japanese to South America. Former broadcasts in Eskimo to North America were also carried on a frequency aimed at the South Pacific.

HCJB's experimental transmission on 26020 kHz results in some strange combinations: German at midnight, Nordic languages at 2000 and 2100, Japanese at 2200, and Portuguese at 2300, all to North America.

Another evangelical, Trans World Radio, sees fertile ground among language minorities, with broadcasts from Bonaire to South America in Russian, and from Swaziland to South and Southwest Africa in German. FEBC from the Philippines has German to the USSR.

Radio Free Europe's Czechoslovak Service has a 10-minute weekly commentary in English, which serves several purposes. The enemy does not bother to jam one of its frequencies, since it's only on the air for that segment; and it allows English-speakers to hear and understand RFE, however briefly. It's Fridays at 2050-2100 GMT during the summer-time in Europe, 2150-2200 the rest of the year, on frequencies in the 19- or 25-meter bands (most recently 15420 kHz), via Portugal.

Radio Sofia, Bulgaria, has broadcasts in Greek and Turkish not only to Greece and Turkey, but also to western Europe, where there are lots of guest workers from those countries.

One of Radio Nederland's several broadcasts in Indonesian is also for western Europe, probably Holland itself, where there is a considerable Indonesian-speaking minority.

Radio Sweden has German not only for Europe but for Africa, and a broadcast in French to South Asia. Both Ger-

many and France once had colonies in these areas. Chile also had broadcasts to Africa in Italian and German, but these appear to have been dropped. Radio Korea has one Spanish broadcast to southeast Asia, presumably for Spanish-speaking remnants in the Philippines. Interestingly, Radio Pyongyang has a broadcast in Russian to the Near and Middle East! (Do they know something we don't know?)

Norway has a weekly 5-minute Spanish segment in its transmissions to all parts of the world, whether or not there are any Spanish-speaking countries in the individual target zones.

While in a slightly different category, an oddball service worthy of note is Radio Portugal's Spanish broadcast at 0230-0300, specifically for Venezuela. It's safe to say this is the only shortwave broadcast on the air especially for that country and not its many Spanish-speaking neighbors.

Radio Cairo broadcasts in Afar, Amharic, Somali and Swahili not only to East Africa, but to South Africa too. These oddball broadcasts have been compiled from schedules issued by the stations or appearing in the *World Radio-TV Handbook*. Not included are such anomalies as the Voice of America broadcast from California to the Philippines in Swahili, since it is intended to be relayed on from there to East Africa.

Changes at Voice of America.

VOA is about to complete phasing in a satellite-feed system to its overseas transmitters, meaning that there will be less need for domestic sites except during emergencies. Dixon, California was mothballed last year, and the same is about to happen to Bethany, Ohio (that antenna farm is readily visible east of I-75, just north of Cincinnati). This will reduce VOA interference to domestic shortwave listeners, but it will also make it harder for us to hear VOA programs. Bethany has been heavily used for secondary services, such as AFRTS, the Voice of the OAS, and United Nations Radio. These will presumably be shifted to Greenville, N.C., unless Bethany receives a reprisal.

The VOA relay in Liberia survived the April coup intact, but VOA had already signed an agreement with Botswana to build another station there. However, it is planned to operate on 621 kHz (mediumwave) only. Part of the agreement is that Radio Botswana gets to use it for domestic services during 12 hours of daytime.

Owing to delays in funding and in finding qualified personnel, the VOA has been slow to react in adding new languages that suddenly become strategically important. VOA plans to add a service in Azeri (understood in Azerbaijan SSR and parts of Iran), and has been criticized for not broadcasting in the primary language of Afghanistan, Pashto. Meanwhile, funding was approved for increased broadcasts to the USSR on Radio Liberty from sites in Israel and Egypt, before those countries had agreed to such an operation. ◇

THE HIERONYMUS MACHINE™

Voice Stress Computer

It's almost beyond belief. This tiny solid-state instrument measures 3" x 6" x 1½" and fits in a pocket. Yet it contains sophisticated electronic circuitry, a microphone, and three red diodes. It analyzes the human voice for stress.

Once you learn, in about 30 minutes, how to use the Hieronymus Machine, you will be able to discover whether a person is calm or stressful — merely by monitoring his or her voice.

DEFINITELY NOT A "LIE DETECTOR"

The Hieronymus Machine is not a lie detector. Nor is it a "truth" device. Even the famed polygraph machine is not a lie detector, plain and simple. The polygraph can be used to monitor a person's pulse, respiration, blood pressure, and galvanic skin response, bodily functions affected by stress.

And in the hands of a skilled operator, the polygraph can be used to gain insights about a person's stress levels when talking about certain topics. But a very real part of the polygraph's usefulness is the "Hieronymus Effect," which we'll get to in a moment.

SPIES AND COUNTERSPIES

During wartime, counterintelligence experts wondered if science could come up with something simpler than the polygraph to help ferret out spies. Researchers became attracted to the theory that human voices emit "micro-tremors," low-frequency vibrations that are generally inaudible or masked by other voice components.

An article in **Popular Electronics** (April 1980) describes the theory in detail. But the short story is that after spending millions of dollars, researchers developed a voice stress analyzer. Now, the authors of the definitive article in **Popular Electronics** have perfected a personal voice stress analyzer, which we call the Hieronymus Machine.

WHAT IT DOES, HOW YOU USE IT

The Hieronymus Machine electronically measures changes in voice micro-tremors. The read-out is simple: one red diode indicates normal, two show moderate stress, and three reveal greater stress, ranging from mild to severe anxiety.

You, as the operator, could use the Hieronymus Machine like a thermometer, checking the "fever level" of stress. As you gain skill, your judgment will im-

prove, enabling you to pursue or avoid a line of questioning or discussion that produces stressful responses.

MANY USES AT HOME OR WORK

You can use the Hieronymus Machine at home to have fun with your family. You'll discover how it responds to different people's voices, what effect laughter and singing have on it, and even evaluate politicians' speeches over TV or radio. It works quite well on transmitted voices, as well as over the telephone or with tape recordings.

Next, try it on friends. See how well someone's favorite fish story holds up when you point out that the Hieronymus Machine doesn't believe a word of it. And watch that poker face disappear as the "stress" diode steadily insists you're not getting the whole story.

BIOFEEDBACK FOR YOU

If you're required to talk in front of groups or need to speak convincingly to one person at a time, you can use the Hieronymus Machine to monitor your voice and learn a more relaxed, self-assured, persuasive style of delivery. If you wanted to learn hypnotism, a relaxed voice would be a real asset — and the Hieronymus Machine could help you achieve it.

At work, there are numerous situations in which the Hieronymus Machine could work wonders. Here's how: Hieronymus Bosch was a 15th-century painter known for his startling originality. He was also something of a medical practitioner, and he believed that patients could be cured by passing stones over their bodies. Bosch achieved success because his patients **believed** that a cure was taking place.

Nearer our own time, a couple of science fiction writers concocted a device they named after Bosch: it produced varying sensations in the user depending on where a dial was set, from zero to 100. The amazing thing was that this machine worked on subjects even when it wasn't plugged in — a perfect Hieronymus Effect!

Now we have a true Hieronymus Machine, the Voice Stress Analyzer. It actually works, and among other things of a scientifically verifiable nature, it produces the Hieronymus Effect. In its presence, people suddenly become more forthright. In some cases, with such a machine present, employees being



asked about office theft became very cooperative in answering questions truthfully. Naturally, you'll want to use the Hieronymus Machine in plain sight and tell people what it does. This actually gets more cooperation from them.

30-DAY TRIAL, MONEY-BACK GUARANTEE

The potential uses of the Hieronymus Machine are limited only by your imagination. Try it at no risk for 30 days. We'll send you one or more with complete instructions (9v. battery not included). You'll be able to try it, experiment, even conduct your own "investigation."

Governments and police departments and huge corporations are already using large (briefcase-sized) versions of this kind of machine, and they have to pay \$3,000 or so for theirs. But you can have a personal Hieronymus Machine for only **\$119.95**. If you're not satisfied, send it back (insured) for a full refund, no questions asked. If you want two, the cost is **\$109.95** each. And if you want three or more for business use, it's only **\$99.95** each. You're also protected by a 1-year parts and labor warranty.

EXCLUSIVE BY MAIL FROM MERCURY

The Hieronymus Machine cannot be obtained in stores or from any other source. To order, send check or money order to the address below. Or charge it on American Express, Carte Blanche, Diners Club, Master Charge or Visa. You can also call us toll free:

800-526-2801
or
800-257-7850

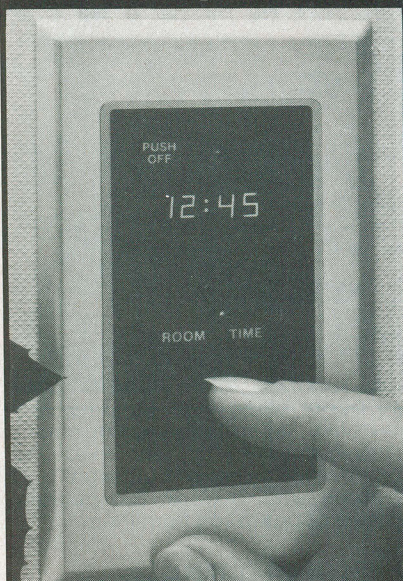
In New Jersey, call toll free 800-322-8650. Include **\$2.50** insured shipping charge per Machine. N.J. residents please add 5% sales tax.

Or mail your order to:

NATIONAL SALES GROUP
MERCURY
THE IMAGINATION PEOPLE®

Dept. PE-9, Lakewood Plaza
Lakewood, New Jersey 08701

NEW! Space Age Security Timer



Put a Computer in Your Wall Switch!

This Space Age Timer goes way beyond ordinary plug-in timers. Pre-programmed Vigilite gives your home a "lived-in" look when you're away. **Installs easily in a wall switch** and turns the overhead light on and off...at slightly different times each day! It controls the kind of light that really makes your home look occupied...even kitchen, bathroom or porch, etc. **Hand-some design fits any decor.** Vigilite even contains an accurate digital clock.

Easy to operate. Each Vigilite contains 5 different lighting programs. Choose and set the one closest to your usual patterns. Your light will go on and off just as though you were there. Of course, you can override the automatic mode anytime by simply touching the built-in switch. For incandescent lights (not fluorescent) up to 300 watts. UL approved.

Homeguardian Products
2991 Meade Avenue • Santa Clara, CA 95051

60 DAY NO RISK MONEY BACK GUARANTEE

Homeguardian Products, Dept. PE980
P.O. Box 4357
Santa Clara, CA 95054

YES! Send me _____ Timers @ \$46.95* (Calif. res. add \$2.80 tax). Save \$15...buy three for just \$125.85* (Calif. res. add \$7.55 tax). If not satisfied, I can return the Vigilite within 60 days for a full refund.

*Incl. \$2.50 per order post./handling

☐ Chk/m.o. for \$_____ enclosed.
☐ Charge my: ☐ Master Charge ☐ Visa
Acc. # _____ Exp. Date _____
Signature _____
Name _____
Address _____
City _____ State _____ Zip _____

**VISA/MasterCard buyers call Toll Free
800-854-2003, Ext. 852
(in Cal. call 800-522-1500, Ext. 852)**

Tips & Techniques

Low-Cost Pulse Detector

Logic transitions (pulses) are the lifeblood of a digital circuit or system. Presented here is a simple pulse detector than can be used to monitor such transitions in TTL networks. Despite its simplicity, the circuit is an effective pulse catcher. It can be assembled from junk-box components in a half-hour or less, and its modest power requirements can be satisfied by the circuit to be monitored. This further simplifies its design.

As shown in the diagram, two of the four NAND gates (*IC1A* and *IC1B*) contained in a 7400 TTL IC are interconnected to form an RS flip-flop. The remaining two gates function as inverters—*IC1D* inverts the logic level at the input probe and *IC1C* inverts the output of the flip-flop. When the output of *IC1C* is logic zero, current flows through *R2* and *LED1*, causing the LED to glow.

The circuit functions in either the HOLD or VIEW mode, depending on the position of *S1*. In the HOLD mode, a logic transition at the input probe changes the state of the flip-flop. The flip-flop remains in the changed state until it is reset by the user. In the VIEW mode, the flip-flop functions as a follower, changing state in step with the input signal.

The LED is a visual indicator of the state of the flip-flop's output. If the circuit is in its VIEW mode and the input signal is a pulse train, the LED will blink on and off. Limitations in the response of the human eye must be considered, however. If the duration of each pulse is very brief and the interval between pulses relatively large, the eye will not see the brief flashes of light from the LED. If the duty cycle and frequency of the pulse train are sufficiently high, the LED will appear to be on continuously when in fact it is rapidly flashing on and off. It is only at relatively low frequencies and large duty cycles that the user will see the LED blinking on and off.

Switch *S2* routes either an inverted or noninverted version of the signal appearing at the input probe to the flip-flop. Switch *S1* selects the operating mode and also functions as a reset switch when the circuit is in HOLD.

The Inexpensive Pulse Detector's circuit is so simple that it can be easily reproduced using perforated board, solder, and point-to-point wiring techniques. Wrapped-wire construction is also suitable. Mount the circuit in any small enclosure.

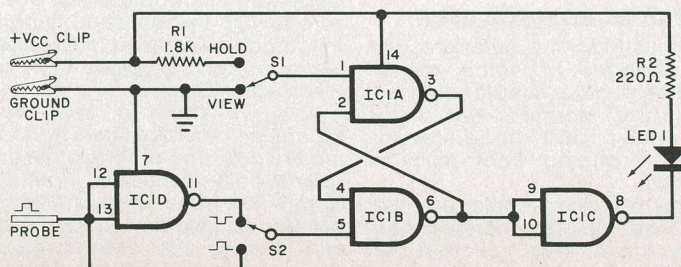
The most convenient housing for the project is a plastic cigar tube. The tube can be drilled to accommodate the LED, input probe, and power leads. (No power source need be included in the project because it can tap the current it needs from the supply of the circuit being monitored.) The circuit board and LED can be secured to the interior of the cigar tube using plastic cement. Two holes should be drilled at either end of the tube—one at the rounded end for the input probe and one in the cap for the power leads. The leads should be terminated with alligator clips and have color-coded insulation. A standard pin jack is the best choice for use as the input probe.

What follows is a description of how the circuit behaves when logic signals are applied to its input probe for the four combinations of switch positions.

If *S1* is in its VIEW position and *S2* in its noninverting position, the LED will remain dark as long as the probe is left floating or connected to a circuit node at logic one. When the input signal changes from logic one to logic zero (or when the probe is touched to a point at logic zero), the LED starts to glow. It will continue to glow until the signal returns to logic one or the probe is removed from the circuit.

If *S1* is in VIEW but *S2* in its inverting position, the LED will glow as long as the probe is left floating or connected to a circuit node at logic one. When the input signal changes from logic one to logic zero (or the probe is touched to a point at logic zero), the LED will go dark. It will remain dark until the input logic level changes from zero to one or until the probe is removed from the circuit node being monitored and is left floating.

The HOLD mode differs from the VIEW mode in that the LED will not flash on and off in step with the input logic signal. Rather, the circuit will be triggered by the first logic transition of the proper



polarity. The LED will be either turned off or on by this transition, depending on the position of *S2*, and will remain on (or off) until the circuit is reset. This is accomplished by momentarily placing *S1* in its VIEW position.

If *S1* is in its HOLD position and *S2* is in its noninverting position, the LED will remain dark as long as the input probe is left floating or is applied to a circuit node at logic one. When the circuit node goes from logic one to logic zero, the LED starts to glow. It will continue to glow until *S1* is momentarily placed in its VIEW position. Note that if the circuit has not yet been triggered, the LED will start to glow as soon as the input probe is touched to a point in the circuit at logic zero. This happens because the project perceives that a negative logic transition has taken place when in fact the circuit node to be moni-

tored has not changed state at all. To reset the circuit so that it can catch and hold the next negative logic transition, simply toggle *S1* to VIEW and then back to HOLD.

Now assume that *S1* is placed in its HOLD position and *S2* in its inverting position. If the input probe is floating or touched to a circuit node at logic one, the LED will glow and continue to glow even if *S1* is placed in its VIEW position. However, if the probe is in contact with a circuit node that is at logic zero before *S1* is placed in its HOLD position, the LED will remain dark until a positive logic transition (zero to one) occurs. Once the circuit has been triggered by a positive logic transition, the LED will continue to glow until the input probe is placed at logic zero and *S1* is toggled from HOLD to VIEW.—*Richard Towle, Bedford, MA.*

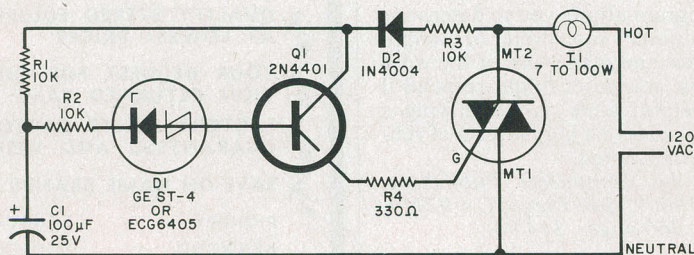
Simple Flasher

Shown here is a simple flasher circuit that can be assembled from standard, readily available parts. With the component values shown, the flash rate is approximately once per second. The incandescent lamp used as a load glows at half brightness for about one-third of the total flasher period and is off for the remaining two thirds.

Electrolytic capacitor *C1* charges up during the positive half-cycle of the ac waveform through *R1*, *R3* and *D2*. When the voltage across the capacitor reaches the breakover voltage of silicon asymmetrical switch *D1* (either 9 or 18 volts), the capacitor starts to discharge through *R2*, *D1*, *Q1*, *R4* and *Q2*. Emitter follower *Q1* is driven by the discharge current from *C1* and in turn provides gate drive for triac *Q2*. Thus, *Q2*

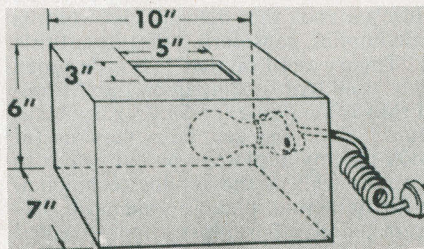
conducts and *I1* glows only while *C1* is discharging. The lamp goes dark when *C1* is depleted of charge and remains dark until the ac power waveform goes positive again and charges the capacitor sufficiently.

Transistor *Q1*, nominally a type 2N4401, can be any medium-current, high-beta npn silicon device with a V_{CEO} rating of 40 volts or more. A triac used for *Q2* should be rated to handle 10 amperes, to withstand 400 volts rms and should be triggered into conduction by a gate current of no more than 5 mA. In many applications, the triac will not have to be heat sunked. The flash rate can be varied by changing the capacitance of *C1*. Using more capacitance results in a slower flash rate, and less capacitance in a faster flash rate.—*Bertram A. Thiel, Frostburg, MD*



PC Board Viewer

The enclosure shown in the figure is a very handy printed circuit board viewer. It was made out of 1/4-inch (6.4-mm) plywood, and the interior was lined with aluminum foil. A 25-watt incandescent bulb and bulb holder were installed to illuminate the inside of the box. In operation, the lamp's line cord is plugged into a power outlet and the printed circuit board to be observed is positioned over the opening on the top of the box. A visual inspection of the board for minute cracks can then be made. The box is also helpful when looking for unbonded foil (blisters) caused by excessive application of heat during soldering, for shorts or causes of leakage paths, for the exact



solder point when removing miniature components from densely packed pc boards such as those found in transistor radios, and when performing general circuit tracing.—*Harry J. Miller, Sarasota, FL.*

DISCOUNT PRICES!

Top Quality Money-Back Guarantee All Factory Prime

MICROPROCESSOR IC'S

Z-80	8.95	6800	6.75
Z-80A	10.95	6802	11.50
8080A	5.50	6502	9.50
8085A	11.95	6504	9.50
Z8001	189.00	6505	9.50
Z8002	139.00	2901	8.95

MICROPROCESSOR SUPPORT IC'S

8212	2.49	Z80-PIO	6.95
8214	3.90	Z80A-PIO	8.25
8216	2.49	Z80-CTC	6.95
8224	2.95	Z80A-CTC	8.25
8226	2.25	Z80-DMA	24.95
8228	4.75	Z80A-DMA	32.95
8238	4.90	Z80-SIO/0	33.95
8251	5.95	Z80A-SIO/0	37.95
8253	19.50	Z80-SIO/1	33.95
8255	5.70	Z80Z-SIO/1	37.95
8257	19.50	Z80-SIO/2	33.95
8259	19.50	Z80A-SIO/2	37.95
6810	4.75	6860	8.95
6820	3.90	6520	6.75
6821	3.90	6522	9.75
6850	4.10	6532	19.95
6852	3.90	6551	13.75

MEMORY • RAMS • PROMS • EPROMS

2114L-450 ns	4.50	2101-450 ns	1.95
2114L-200 ns	5.95	21L02-250 ns	1.10
4044-450 ns	4.25	21L02-450 ns	.99
4116-200 ns	7.95	2111-450 ns	2.95
4116-150 ns	12.95	2112-450 ns	1.95
4096-5	3.50	2147-85 ns	19.95
MCM 6604 AC	3.50	2708-450 ns	8.95
AM 9060 CDC	2.95	2716-450 ns	25.95
5101-3	4.95	2732-450 ns	79.95

SOUND GENERATORS

SN76477	Complex Sound Generator	2.49
AY-3-8910	GI Sound Gen. (Add \$3.00 for manual) 64 Pgs.	11.95

UARTS

AY-5-1013A	3.95	AY-3-1015A	5.10
AY-3-1014A	6.50	TR1602A	3.50

LINEAR

LM 301N-8	32	LM 340T Series	1.15
LM 301AH	32	LM 387N-8	.99
LM 307N-8	25	LM 393N-8	.99
LM 307H	25	LM 3900N-14	.58
LM 308H	75	LM 3909N-8	.99
LM 311N-8	59	LM 739DC-14	.99
LM 319H	90	LM 741CN-14	.19
LM 320K Series	1.35	LM 747CN-14	.59
LM 320T Series	1.15	RC 1556NB-8	1.25
LM 323K	4.95	LM 4250CH	.95
LM 339N-14	.98	CA 3130T	2.25
LM 340K Series	1.35	LM 4136N-14	.95
		LM 383T	1.25

SOCKETS

Low Wire Wrap #3				Low Wire Wrap #3			
Profile	Gold	Tin		Profile	Gold	Tin	
8 Pin	14	49	29	22 Pin	28	99	69
14 Pin	16	57	37	22 Pin	16	99	70
16 Pin	20	61	41	24 Pin	36	110	85
18 Pin	10	89	59	28 Pin	39	139	110
20 Pin	28	99	69	40 Pin	55	175	140

SPECIALS OF THE MONTH

While Supply Lasts

ECL 10146L RAM 1024X1-29 ns	6.95
AM 3705 PMOS 8-Ch. Multiplexer	8.95
MM 500H Dual 25-Bit Shift Register	.49
TR1671 Asyn/Sync Receiver - Transmitter	16.95
95H90 Hi-Speed Div. 10/11 Prescaler	10.95
MCT6 Dual Opto. Isolator 1500V	.99
ICL 7107 CPL 3 1/2-Digit A/D Conv. LED	11.50
AY-5-2376 Keyboard Encoder, 88 Keys	10.50
AY-5-3600 Keyboard Encoder, 90 Keys	9.95
1488 or 1489 Liner Driver/Receiver	.99
18-Pin Low Profile Sockets End Stackable	1.10

HOW TO ORDER—Pay by check, credit card, or C.O.D. Foreign pay in U.S. Funds. Order by phone or mail. \$100 minimum. Prices valid thru last day of cover date. Shipping—\$2.00 for the first 2 lbs. For surface add 35¢ for ea. add'l lb. For air add 70¢ for each add'l lb. Foreign—Add 10% for shipping and handling. C.O.D.'s add \$1.85. Guaranteed satisfaction or your money back. We reserve the right to limit quantities. Some items subject to prior sale. We are not responsible for typos. SEND FOR OUR FREE FLYER! Contains complete list of 74LS100 IC's.



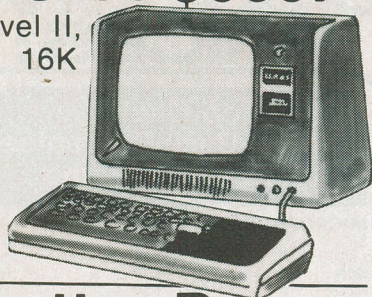
Components Express, Inc.

1380 E. Edinger, Unit PE
Santa Ana, CA 92705
(714) 558-3972

"Have you kissed your computer lately?"

TRS-80 \$669.

Level II,
16K



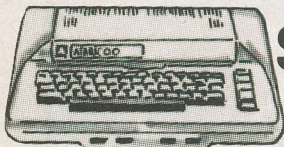
Chatter Box



\$259.⁹⁵

Full 8-bit parallel port — Acoustic modem
RS-232-C port (up to 19,200 baud)
TRS-BUS connector for future expansion.
Connects directly to the keyboard
Includes terminal software

Atari 800 16K RAM



\$819.

Atari 400 \$499.

PET_{16K}

\$895.



PET_{32K} \$1195.

Send \$1. for our complete catalog featuring
HARDWARE/SOFTWARE/BOOKS
FOR THE TRS-80, Apple, Atari and
Pet. You also get a \$2. credit toward
your first order.

TO ORDER TOLL FREE
800-258-1790

(In NH call 673-5144)
6 South St.,
Millsfield, NH 03055
HARDSIDE

CIRCLE NO. 75 ON FREE INFORMATION CARD



Electronics Library

The Radio Amateur's Handbook 1980 (Fifty-Seventh Edition)

by the ARRL Headquarters Staff

This latest incarnation of the venerable *Radio Amateur's Handbook* continues the trend of recent editions in its increased emphasis on physics concepts in the presentation of such topics as transmission lines, antennas, shielding, etc. Also, the increased use of VMOS devices, toroidal inductors and transformers, linear and digital ICs, doubly balanced mixers and other components in the circuits presented in the Handbook reflect the evolution of communications electronics.

Published by the American Radio Relay League, 225 Main Street, Newington, CT 06111. 576 pages. Hard cover \$15.75 in the U.S., \$18 in Canada and elsewhere. Soft cover \$10 in the U.S., \$11 in Canada, and \$12.50 elsewhere.

The BASIC Handbook

by David A. Lien

This new book can prove to be an invaluable aid in getting published BASIC programs to run in your computer. It lists the various BASIC statement/command words and existing variations used in 78 popular BASICs. An explanation of the word tells what it is and does. Then a program allows you to determine if your computer's interpreter or compiler recognizes and makes use of the word and how the computer might respond if it does. Helpful hints on simplifying a program to achieve a higher level of reliability are then noted.

Published by Compusoft Publishing, P.O. Box 19669, San Diego, CA 92119. Soft cover. 360 pages. \$14.95.

Audio Servicing

by Andy J. Wells

Here's a book that delivers just what its title implies, considering that its subtitle is "Theory and Practice." (It is designed to be used with a companion Lab Manual that is available for \$4.95.) By itself, *Audio Servicing* can be a very useful book for any audio-equipment owner to have, as well as the service technician. With numerous photos, schematic diagrams, and other illustrations, backed up by well-written and easy-to-understand text, it succeeds in explaining every part of an audio system in non-technical terms.

Published by Gregg/McGraw-Hill Book Co., 1221 Ave. of Americas, New York, NY 10020. Soft cover. 228 pages. \$8.95.

FREE CATALOGS

☐ **Software.** Lists 400 programs on 70 tapes and disks. For education, recreation, and personal use.

☐ **Books.** Lists 100 books, games, records, prints, etc. for educational and personal users of small computers.

☐ **Peripherals.** (ALF music synthesizer and Versa-Writer for the Apple II).

Send 3 15¢ stamps for either catalog or 5 for both. Or send \$2.00 for a sample issue of *Creative Computing* and both catalogs.

creative computing

DEPT. PEJG
P.O. Box 789-M
Morristown, NJ 07960

SAVE!

MONEY • TIME • FREIGHT

QUALITY STEREO EQUIPMENT
AT LOWEST PRICES.

YOUR REQUEST FOR QUOTATION
RETURNED SAME DAY.

FACTORY SEALED CARTONS—
GUARANTEED AND INSURED.

SAVE ON NAME BRANDS LIKE:

PIONEER	SANSUI
KENWOOD	DYNACO
SHURE	SONY
MARANTZ	KOSS

AND MORE THAN 50 OTHERS
BUY THE MODERN WAY
BY MAIL—FROM

illinois audio

BANK CARDS ACCEPTED

12 East Delaware
Chicago, Illinois 60611
312-664-0020

CIRCLE NO. 36 ON FREE INFORMATION CARD

FLASHING L.E.D.
Litronix FRL-4403
diffused red led with built
in flashing unit
T 1 1/4 package
pulse rate 3hz @ 5v 20 ma.
2 for \$1.70

AXIAL ELECTROLYTIC CAPACITORS
8,000 MFD 15VDC \$1.50 ea.
3/16" long x 1-1/16" diameter
600 MFD. 100 VDC \$1.00 ea.
2-1/16" long x 1" diameter
4,700 MFD 16 VDC 2 for \$1.50
2" long x 1" diameter

DUAL 50K SLIDE POT
linear taper \$1.50 each
3 inch long 2 1/4 inch slide
knobs for slide pots 20c each

50K SLIDE POT 75c Each
Knobs for Slide
Pots 20c each audio taper
• 3-1/2 inch long • 2-3/4 inch slide

TRANSFORMERS
115 volt primaries
3 VOLTS @ 200MA. \$1.25
6 VOLTS @ 250MA. \$1.25
12.6 VOLTS C.T. @ 250MA. \$1.50
12.6 VOLTS C.T. @ 1 AMP. \$2.75
16.5 VOLTS @ 3 AMP. \$6.50

ALCO HEAVY DUTY MINIATURE SIZE TOGGLE
• Rated: 10 amps @ 120 vac
• Contacts: solid silver S.P.D.T.
• Body Size: 9/16" dia.
• cylindrical body 3/4" high
\$1.50 each specify handle style
Miniature Flat Lever MCT-1100 40
Standard Bat 15/32 MCT-1100
Miniature Bat 1/40 MCT-1100
22,000 MFD. @ 50VDC
COMPUTER GRADE CAPS.
4 1/4" high x 3" \$3.50 clamps 50c

POTTER BRUMFIELD 4 PDT RELAYS
• 14 pin style
• 3 amp contacts
• 24 V.D.C. or
120 V.A.C. coil
• Used but fully
tested
\$1.50 each
specify coil voltage
LARGE QUANTITIES AVAILABLE
22/44 EDGEBOARD CONNECTOR
TIN SOLDER TAIL .156" x .200"

PHOTO — FLASH CAPACITOR
1100 MFD 330 VOLTS
3 1/4" x 1 1/4" \$1.50 Each

3x5" OAKTRON SPEAKER
3 oz. Magnet
8 OHM Impedance
\$2.50 each
LARGE QUANTITIES AVAILABLE

ALL ELECTRONICS CORP.

905 S. Vermont Ave. SEND FOR OUR FREE CATALOG
Los Angeles, CA 90006
(213) 380-8000
Store & Warehouse Hours
9 AM - 5 PM
Monday thru Friday
Saturday
10 AM - 3 PM

TERMS

- Quantities Limited
- Min. Order \$10.00
- Add \$2.00
- Shipping USA
- Calif. Res. Add 6%
- Prompt Shipping

CIRCLE NO. 2 ON FREE INFORMATION CARD

apple computer

Complete Microprocessors line, peripherals & Terminals.

APPLE II PLUS, 16K \$ 995.00	Disk II/controller ..\$ 535.00
SOROC IQ120 845.00	SOROC IQ140 1395.00
ADM3A, assembled.. 840.25	TI-99/4 w/monitor 999.00
TI-745 1440.00	TI-810 1715.00

Texas Instruments

Invest. Anal... 49.95	Speak & Spell \$59.00
TI-55 35.50	Spelling Bee. 30.95
Accessories .. call us	TI-Programmer 52.50
TI-58C 92.90	MBA 52.50
PC100C 162.00	TI-5100 37.50
TI-59 208.50	TI-5015 59.00
Dig. Therm. 105.00	TI-5025 61.95
Lang. Trans. 225.00	TI-5040 79.00

HEWLETT-PACKARD

HP-67\$299.00	HP-41C Prog 243.00
HP-97584.50	HP-41C Printer 327.00
HP-33C 89.95	HP-41C CRD RDR 177.95
HP-34C 124.95	HP-41C Mem. Module 40.00
HP-38C 124.95	HP-32E 56.00

HP-85 CALL US FOR PRICES

SCM TYPEWRITER SPECIALS

SCM-2200\$269.00	INTREPID\$274.00
SCM-2500 279.00	CLASSIC 12 144.00

All units shipped in original cartons with accessories according to manufacturer's specification. Send money orders, personal check (2 weeks to clear). In Illinois add 6% sales tax. Add \$4.95 minimum shipping & handling charges per unit. We ship UPS. Subject to availability. Written warranty for specific products can be obtained free upon request. Above prices are for mail order and prepaid only. Prices and specifications subject to change without notice. Send mail orders

Nabih's, Inc.

519 DAVIS, EVANSTON, ILL. 60201 TEL: 312-869-6144

CIRCLE NO. 51 ON FREE INFORMATION CARD

New Literature

Reference Manual for The Imagination Machine

A Technical Reference Manual on APF Electronics' Imagination Machine includes chapters on memory maps, memory usage for programs and variables, and entering and using machine language. Appendices include schematics and parts layout. Written for The Imagination Machine purchaser who would like to have more knowledge about how it works. Send \$2, postage and handling, to APF Electronics Inc., 444 Madison Ave., New York, NY 10022.

Dolby HX Literature

In a four-page pamphlet, Dolby Laboratories describes the theory and operation of its new Headroom Extension (HX) circuit configuration now appearing in cassette decks on the audio market. Through signal-controlled variation of a deck's recording bias and equalization, Dolby HX is said to achieve a dynamic-range increase on the order of 10 dB at high frequencies. Address: Dolby Laboratories, 731 Sansome St., San Francisco, CA 94111.

Printed-Circuit Design Bulletin

An updated Bulletin (Vol. III, No. 1) from Bishop Graphics features new printed-circuit artwork patterns recently introduced by the company. Included are solder mask artwork patterns, feed-through conductor patterns for creating multi-color DIP stikons, dual in-line patterns, multipurpose prespaced pads, and templates. Address: Bishop Graphics, 5388 Sterling Center Dr., Box 5007, Westlake Village, CA 91359.

Gas-Discharge Displays

A four-page brochure from Boston Electronics Corp. covers its Optnix series of planar gas-discharge displays. Included are descriptions of the 2-inch and 3.1-inch high digits, typical circuitry, and tables of electrical and mechanical properties. Address: Boston Electronics Corp., 68 Harvard St., Brookline, MA 02146.

Hard-to-Find Tool Catalog

A new catalog of tools for electronic assembly and precision mechanics from Jensen Tools Inc. includes over 2,000 tools. Included are micro-tools, test and soldering equipment, tweezers, screwdrivers, cutters, drafting supplies, power tools, and a line of kits and cases. Address: Jensen Tools Inc., 1230 South Priest Dr., Tempe, AZ 85281.

TUNE IN!

Build the World Famous CHROMA-CHIME KIT

Give your friends a warm welcome. Yes, think how delighted and amazed they will be to hear the musical Chroma-Chime play when they press the front door bell!

The Chroma-Chime uses a microcomputer to play 24 well-known tunes instead of the regular ding-dong bell or buzzer. This British designed unit uses a Texas Instruments TMS 1000 specially programmed with a complete repertoire of tunes built in. The kit is simplicity itself for ease of construction. Absolutely everything needed is supplied, including:

- * Resistors, Capacitors, Diodes, Transistors, I.C. Socket and all hardware
- * Texas Instruments TMS 1000 microcomputer
- * Comprehensive kit manual with full circuit details
- * Ready drilled and legended PCB included

only
\$39.95
incl. p & p

When built, simply substitute for your old door chime or bell, no additional wiring needed, can be operated either from a 16 volt AC transformer or from two regular 9 volt batteries.

Plays 24 well-known tunes including:

Star Spangled Banner
William Tell Overture
Greensleeves
Mozart Sonata
Oh come all ye faithful
plus many other popular favourites.

- * No previous microcomputer experience necessary
- * All programming retained is on chip ROM
- * Fully guaranteed.

TMS 1000 N-PM0027A
Microcomputer chip
available separately if
required. Full 24 tune device supplied
with data sheet and fully guaranteed
only \$12.50 incl. p & p.

To order, send either a personal check or money order, alternatively we can deduct from your Visa or Master Charge account.

Absolutely no risk, money back if not delighted. \$39.95 inclusive of air mail, direct to the USA. Delivery may take 14 to 28 days.

Ordering from the UK is just like any other place in the USA. 10,000's already sold!

To: CHROMATRONICS, RIVER WAY, PE-80
HARLOW, ESSEX, ENGLAND.
Our phone (01144) 279 418611

Please send me kits

NAME

ADDRESS

.....

.....

I enclose checks value \$

or debit my Visa /Master Charge account no:

.....

Signature

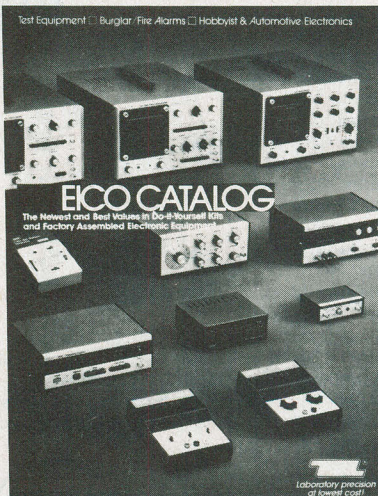
Dealers note: Available in kit or

ready built from: Timely Products

Sales Inc. Chicago. Tel: (312) 263 6231

CIRCLE NO. 13 ON FREE INFORMATION CARD

The world of electronics gee-wizardry



-YOURS FREE.

32-pages of test instruments — from the latest digital multimeters to the famous EICO scopes. Security systems. Automotive and hobbyist products. Kits and assembled. EICO quality. EICO value. For FREE catalog, check reader service card or send 50¢ for first class mail.



108 New South Road
Hicksville, N.Y. 11801

CIRCLE NO. 80 ON FREE INFORMATION CARD

Operation Assist

If you need information on outdated or rare equipment—a schematic, parts list, etc.—another reader might be able to assist. Simply send a postcard to Operation Assist, POPULAR ELECTRONICS, 1 Park Ave., New York, NY 10016. For those who can help readers, please respond directly to them. They'll appreciate it. (Only those items regarding equipment not available from normal sources are published.)

Bell & Howell model 34 oscilloscope. Need schematic and alignment information. Charles Kneibler III, 1751 New Ashland City Hwy., Clarksville, KY.

Jackson Electric Co., TV sweep/marker generator. Need schematic and any available information. Douglas Young, 4314 Wyoming Ct., Virginia Beach, VA 23456.

Precision series E-400 sweep generator. Need operating manual. Norman Schmidt, 3301 Rollingwood Dr., Gastonia, NC 28052.

Zenith model 8B01 wavemagnet AM radio. Need schematic and parts list. Robert M. Shuster, 210 Briar Ave., North Canton, OH 44720.

Approved Electronic Instrument Corp., model A-200 r-f signal generator. Need schematic or address of company. Dan Bleicher, 8820 Van Nuys Blvd. #6, Panorama City, CA 91402.

Stromberg-Carlson No. 920-H radio receiver. Need schematic or specifications on power transformer. Charles Cline, 6334 Ben Ave., N. Hollywood, CA 91606.

Olympic model CT-400 (chassis CT-1990) TV. Need high voltage transformer part #TRJ-61442. William J. Maide, 341 Isabella Dr., Longwood, FL 32750.

Simpson model 310 signal generator. Operating manual and schematic needed. Elden Perry, Box 441, Nashville, MI 49073.

Thordarson type T11K16 oscilloscope. Need schematic. Nicholas Mulchin, 232 Willow St., Meadville, PA 16335.

Electro Instruments, Inc., model 405 digital voltmeter. Need schematic, manual, any available information and company address. Frank Nally, 1127 Berkeley Sq., Louisville, KY 40213.

Precision Apparatus Co., series ES-500A oscilloscope. Manual and schematic needed. Dewey Parlier, 3311 Wide Country Rd., Pfafftown, NC 27040.

Lear, Inc., model ADF-12, ADF-12C, ADFL-12 orienter. Need schematic and manuals. Greg Woods, PO Box 69, Moosomin, SK, S0G 3N0 Canada.

Dumont model 3044 oscilloscope. Need instruction manual. L.E. Weiss, Sr., 14518 S. Disney Ave., Norwalk, CA 90650.

Aaron model B606 reel-to-reel tape recorder. Need schematic and manuals. E.R. Gamble, 1053 Elm St., Clinton, IN 47842.

Pilot model TV 37 television. Need kinescope 3KP4. Barry Dalton, 10354 Danube Ave., Granada Hills, CA 91344.

Philco model 610 radio. Need antenna transformer (original part #32-1669). Glen Steinman, 7915 E. Michigan Ave., Jackson, MI 49201.

Hallcrafters SX-100 receiver. Need schematic, operating manual and any available information. Alan Herbach, 27200 Franklin Rd., Apt. 622, Southfield, MI 48034.

Simpson model 480 genescope. Need manuals, schematics and calibration data. Emil Huddy, 45541 Rd. 200, North Fork, CA 93643.

Grunow model 501 AM radio. Need schematic, parts list and service information. Doug Lobb, 6815 X St., Lincoln, NE 68505.

Jackson model TVG-2 TV sweep/marker generator. Schematic and manuals needed. Ted Wilson, Isabell Enterprises, 12439 So. Giles St., Las Vegas, NV 89119.

(Continued on page 127)

Take 20% Off
Any Order
Totaling \$30
Or More!

BACK TO SCHOOL SALE

- ☐ 10-QUAD PHONO JACKS, 4 RCA jacks on 2 x 1 1/2" Bakelite strip, (#6249) 2.99
- ☐ 50-RCA PHONO PLUGS, popular audio/speaker plugs, 100% material, (#3293) 2.99
- ☐ 25-MINI PLUG & CABLE SETS, 3.5mm plug, 6' insulated 2 cond. leads, (#6269) 2.99
- ☐ 25-MAGNETIC DISCS, Plastalloy 13/16 dia. x 1/8" discs, (#6294) 2.99
- ☐ 250-PRE-FORMED DISCS, caps w/leads for PC use, mixed values, (#2605) 2.99
- ☐ 30-PLASTIC POWERS, 25 watt, npn & pnp, 50-200 bycho, TO-220, (#6237) 2.99
- ☐ 100-2 WATT RESISTORS, assorted carbons, films etc. some 5%ers, (#6238) 2.99
- ☐ 24-1M-340T VOLTAGE REGULATORS, untested TO-220, may incl. 5-24V, (#2635) 2.99
- ☐ 150-POLYSTYRENE CAPS, assorted types, styles, & sizes, all good, (#2729) 2.99
- ☐ 200-COILS & CHOKES, asst. RF, OSC, IF, and peaking types, (#6283) 2.99
- ☐ 50-POWER TAB TRANSISTORS, plastic NPN, TO-220, asst. types, untested, (#2425) 2.99
- ☐ 24-SKINNY TRIM POTS, multi & single turn, asst. values & types, (#6285) 2.99
- ☐ 3-25A 50V BRIDGES, "block" type, with four lug-type leads, (#6311) 2.99
- ☐ 100-TTLs, 7400 series, incl. gates, flip-flops, etc. untested, (#6226) 2.99
- ☐ 5-BRASS LOCKS, with key, 1 1/2" long, for doors, windows, etc, (#6253) 2.99
- ☐ 250-MOLEX SOCKETS, "on-a-strip", make your own pc sockets, (#6255) 2.99
- ☐ 50-MINI POTS, pc style, single turn, assorted values, (#3345) 2.99
- ☐ 20-JUMBO RED LEDS, 3V 10mA, 100% good material, red dome lense, (#3369) 2.99
- ☐ 3-SOUND TRIGGERS, sound activated amp, SCR triggered, on 3" board, (#3625) 2.99
- ☐ 50-TRANSISTOR SOCKETS, assortment may include: TO-19, 5, 6, 6.3, etc, (#3845) 2.99
- ☐ 100-CABLE TIES, 4" non-slip white plastic, like Ty-wrap, (#5218) 2.99
- ☐ 150-FEEDTHRU CAPS, assorted types & sizes, for RF, UHF, etc, (#5668A) 2.99
- ☐ 250-1/4 WATT RESISTORS, asst. carbons, carbo-films, some 5%ers, (#5797A) 2.99
- ☐ 100-PLESSY CAPS, ceramic blocks in assorted sizes & values, (#6221) 2.99
- ☐ 30-HOBBY LEDS, assorted types & colors, mostly dims, some good, (#6225) 2.99
- ☐ 150-PC-HEATSHRINK, slip-over type, shrinks 50%, like Thermo-Fit, (#6239) 2.99
- ☐ 30-NE-2 BULBS, neon, for 110 VAC, requires resistor, (not incl.) (#2613) 2.99
- ☐ 100-METAL FILM RESISTORS, mostly 1/2 watters, asst. val. 1-5% tol, (#6280) 2.99
- ☐ 100-POWERS POWERS, 3 to 7 watt power resistors, (#6281) 2.99
- ☐ 25-CRYSTALS, assorted types, some H6/U, some frequency marked, (#6256) 2.99
- ☐ 150-SUBMINI IF TRANSFORMERS, asst. may include: osc. antenna, etc, (#6259) 2.99
- ☐ 60-SQUARE OHM RESISTORS, prime resistors, asst. values, grab 'em! (#6261) 2.99
- ☐ 30-MICRO MINI REED SWITCHES, 1" long, for alarms, relay systems, etc, (#6263) 2.99
- ☐ 200-PC-CAPACITOR SPECIAL, asst. mylars, polys, micas, etc, 100% good, (#6264) 2.99
- ☐ 20-PUSHBUTTON ALARM SWITCH, SPST, momentary, NC, w/hardware, (#6267) 2.99
- ☐ 500-PC-HARDWARE SURPRISE, (approx.) 1 lb. asst. screws, washers, etc, (#6271) 2.99
- ☐ 30-9V BATTERY CLIPS, snap connector, coded, insulated leads, (#6286) 2.99
- ☐ 6-WATCH GUTS, 5-function, LED style, assorted sizes, untested, (#6287) 2.99
- ☐ 10-HEAVY DUTY LINE CORDS, white, 2 cond. 6 ft. 16 gauge, (#6292) 2.99
- ☐ 20-SINGLE PIN LEDS, green, micro style, 3V 10mA, 100%, (#6293) 2.99
- ☐ 40-LED/TRANSISTOR SOCKETS, "snap-in", 3 pc leads, for TO-5, 18, 46, etc, (#6297) 2.99
- ☐ 200-PRECISION RESISTORS, 1/2W, 1%, asst. sizes, speeds & types, 1.5-12 volt, (#2551A) 2.99
- ☐ 15-MOTORS MOTORS, asst. sizes, speeds & types, 1.5-12 volt, (#2551A) 2.99
- ☐ 150-LONG LEAD DISCS, prime, marked caps, assorted material, (#2598) 2.99
- ☐ 100-PLASTIC TRANSISTORS, untested, TO-92, asst. types, (#2604) 2.99
- ☐ 50-SLIDE SWITCHES, various shapes, sizes, and types, (#2726) 2.99
- ☐ 75-TRANSISTOR ELECTROLYTICS, epoxy encapsulated, asst. values, (#2747) 2.99
- ☐ 25-HALF WATTERS, 100% color-coded resistors, asst. values, (#3046) 2.99
- ☐ 25-SLIDE VOLUME CONTROLS, various values & types, for HI-FI, etc, (#3057) 2.99
- ☐ 50-UPRIGHT ELECTROS, 100%, assorted values & voltages, marked, (#3226) 2.99



*SALE ENDS: November 1, 1980
Discount To Be Taken BEFORE Postage Is Added.



CIRCLE NO. 62 ON FREE INFORMATION CARD

PET COMPUTER KEYBOARDS

\$39.95
Cat. No.
92CU6671
Wt: 10 oz.

- ASCII Compatible Original Factory Keyboards
- Includes; 53-Key Alphanumeric, PLUS 20-Key Hexadecimal Arrays!



Complete 73-Key PET keyboards include all Alphabetical, Numeric, Graphics, Game, and Command legends commensurate with the PET 8K microcomputer. 64 ASCII characters are available without shift and all 64 graphics & reverse field characters are accessible from keyboard (with shift). Keys are color-coded for quick reference, and are precision mounted in a compact 9 1/2" x 3 7/8" high impact plastic frame. Terminates in standard 18-contact single-sided edge connection. Removed from equipment, 100% functional.



TANK GAME CHIP & BOARD SET

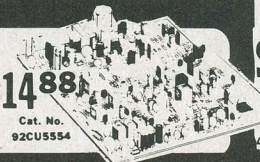
• General Instruments
\$14.88
Cat. No. 92CU6526 AY-3-8700-1

General Instrument's AY-3-8700-1 Tank Battle Game Chip and board set. 28 pin DIP

TANK GAME CHIP LESS BOARD Cat. No. 92CU6505 **\$9.95**

40 CHANNEL CB BOARD

\$14.88
Boards have
Phase Lock Loop IC, Heat
sunk 9W Amp Chip, RF
and Modulation transistors.
Size: 6" x 6" x 2" (H). Wt. 9 oz.
Cat. No.
92CU5554



MOTOROLA AM/FM PUSHBUTTON CAR STEREO

\$49.95
Cat. No. 92CU6551

Adjustable Shafts 5 lbs.
In/Under Dash Mount
"Factory Installed" Quality
4 Speaker Stereo Reproduction

SEND FOR FREE CATALOG

POLY PAKS

P.O. BOX 942, E9
SOUTH LYNNFIELD,
MASS. 01940

HOW TO ORDER
We honor MASTERCARD, VISA, Check, & C.O.D..
Order by Phone or Mail. Min. Order: USA & Canada:
\$10. Foreign: \$20. Please state Cat. No. & Description,
Name & Month of magazine. Please Enclose for
POSTAGE & HANDLING: USA: \$5, Canadian: \$8,
Foreign: \$20. (US Funds). OPEN ACCOUNTS: (Must
be listed & rated in D&B) Net-30, (\$25 minimum).
PHONE: (617) 245-3828
C.O.D. ORDERS: Payment must be made via Cash,
Postal Money Order, or Certified Check. C.O.D.
charges will be added to the order.

FREE INFORMATION:

Learning more about a product that's advertised or mentioned in an article in this month's issue is as simple as one, two, three. And absolutely free.

1 Print or type your name and address on the attached card. Use only one card per person.

2 Circle the number(s) on the card that correspond to the number(s) at the bottom of the advertisement or article for which you want more information.

(Key numbers for advertised products also appear in the Advertisers' Index.)

3 Simply mail the card, and the literature will be mailed to you free of charge from the manufacturer.

FREE INFORMATION:

This address is for our product Free Information Service only. Editorial inquiries should be directed to POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

POPULAR ELECTRONICS

USE ONLY ONE CARD PER PERSON

PE9803

NAME _____

COMPANY NAME (If applicable) _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

(Zip Code must be included to insure delivery.) (Void after Nov. 30, 1980)

Are you planning to purchase a micro computer?

a. ☐ Yes

b. ☐ No

For which application?

a. ☐ Business

b. ☐ Home

c. ☐ Both

4 ☐ Please send me 12 issues of Popular Electronics for \$9.97 and bill me.

(Full Subscription Price \$14.00)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

POPULAR ELECTRONICS

USE ONLY ONE CARD PER PERSON

PE9802

NAME _____

COMPANY NAME (If applicable) _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

(Zip Code must be included to insure delivery.) (Void after Nov. 30, 1980)

Are you planning to purchase a micro computer?

a. ☐ Yes

b. ☐ No

For which application?

a. ☐ Business

b. ☐ Home

c. ☐ Both

4 ☐ Please send me 12 issues of Popular Electronics for \$9.97 and bill me.

(Full Subscription Price \$14.00)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

POPULAR ELECTRONICS

USE ONLY ONE CARD PER PERSON

PE9801

NAME _____

COMPANY NAME (If applicable) _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

(Zip Code must be included to insure delivery.) (Void after Nov. 30, 1980)

Are you planning to purchase a micro computer?

a. ☐ Yes

b. ☐ No

For which application?

a. ☐ Business

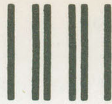
b. ☐ Home

c. ☐ Both

4 ☐ Please send me 12 issues of Popular Electronics for \$9.97 and bill me.

(Full Subscription Price \$14.00)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120



No postage
necessary
if mailed
in the
United States

BUSINESS REPLY CARD

First Class

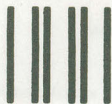
Permit No. 217

Clinton, Iowa

POSTAGE WILL BE PAID BY

Popular Electronics

P.O. Box 2905
Clinton, Iowa 52735



No postage
necessary
if mailed
in the
United States

BUSINESS REPLY CARD

First Class

Permit No. 217

Clinton, Iowa

POSTAGE WILL BE PAID BY

Popular Electronics

P.O. Box 2905
Clinton, Iowa 52735



No postage
necessary
if mailed
in the
United States

BUSINESS REPLY CARD

First Class

Permit No. 217

Clinton, Iowa

POSTAGE WILL BE PAID BY

Popular Electronics

P.O. Box 2905
Clinton, Iowa 52735

Popular Electronics

reprint series

Many important articles covering a variety of interests in the broad field of electronics are published in POPULAR ELECTRONICS. Reprints of selected articles and test reports are now available in the event that you missed some you would like to have for reference or study purposes—or for projects you wish to build. Reprints are only \$2 each; \$1 for those marked with an asterisk. Minimum order \$5.

Test reports

AUDIO

- 40871 ADC Accutrac 4000 Record Player
- 40874* MXR Stereo Graphic Equalizer
- 40875* Nakamichi Model 500 Stereo Cassette Deck
- 40878* Pickering Model XV-15/625E Stereo Phono Cartridge
- 40879 Pioneer Model CT-F8282 Stereo Cassette Deck
- 40886* Stanton Model 681EEE Stereo Phono Cartridge
- 40887 Teac Model PC-10 Portable Stereo Cassette Deck
- 40889* Thorens Model TD-126C Record Player
- 40969* Akai Model GX-270D-SS Four-Channel Tape Recorder
- 40970 Speakerlab Model S7 Speaker System Kit
- 40972* Dual Model 1245 Automatic Turntable
- 40973* Burwen Model DNF 1201A Noise Reducer System
- 41105 Yamaha Model CR 2020 AM/Stereo FM Receiver
- 41106* Optonica Model RT-3535 Stereo Cassette Deck
- 41107* dbx Model 128 Dynamic Range Enhancer
- 41108* Garrard Model GT25 Automatic Record Player
- 41109* Sansui Model AU-717 Integrated Amplifier
- 41110 Sherwood Micro/CPU 100 FM Tuner
- 41111* Sony Model PS-X5 Turntable
- 41112* JVC Model P-3030 Stereo Preamplifier
- 41113* Dahlquist Model DQ-1W Low-Bass Module
- 41315 Sony "Class D" Amplifier
- 41316 Electrovoice "Series II" Speakers
- 41317 AR 9 Speakers
- 41318 JVC Jt-V77 FM Tuner
- 41319 Pioneer CT-F900 Cassette Deck
- 41320 Luxman R-1120 Receiver
- 41321 Dual C-819 Cassette Deck
- 41322 B.I.C. 2-speed Cassette Deck
- 41323 SAE Two Amplifier and Tuner
- 41324 Hitachi Mosfet Power Amp
- 41325 Akai PO-1000 Open-Reel Tape

COMMUNICATIONS

- 40890* Cobra Model 29XLR 40-Ch. AM CB Mobile Transceiver
- 40891* Drake Model SSR-1 AM/SSB Communications Receiver
- 40892* Kenwood Model TS-820 Amateur Radio Transceiver
- 40893* Kris Model XL-50 40-Ch. AM CB Mobile Transceiver
- 40894* President Model "Washington" 40-Ch. AM/SSB CB Base Station
- 40971* General Electric Model 3-5825 AM/SSB CB Transceiver
- 40974* Realistic Model TRC-449 Mobile AM/SSB CB Transceiver
- 41114 Ten-Tec Century/21 Ham Transceiver
- 41326* Panasonic 5-Band SW Portable
- 41327* Electra Microprocessor Scanner

*Reprints are \$2 each; \$1 for those marked with asterisk. Minimum order \$5.

HERE'S HOW TO ORDER

Mail your order along with your name, address, and remittance in the amount of \$2.00 for each reprint; \$1.00 for reprints marked with an asterisk.

Residents of CA, CO, DC, FL, IL, MI, MO, NY STATE and VT add applicable sales tax.

Please be sure you identify reprints being ordered by the appropriate #'s shown above.

OUTSIDE U.S.A. ADD \$2 PER ORDER. MINIMUM ORDER \$5.

ORDER FROM:
POPULAR ELECTRONICS REPRINTS,
P.O. Box 278, Pratt Station, Brooklyn,
New York 11205.

CALL TOLL-FREE
800-223-2706

Automatic Electronics
1263 Broadway New York, N.Y. 10001

BLANK TAPES		RECORDS	
(Minimum Order-10 Tapes)		ENTIRE SCHWANN CATALOG	
MAXELL		ROCK, JAZZ, R&B	
C-90 UDXL-II or I	3.39	(Minimum Order 4 Records)	
C-60 UDXL-II or I	2.49	All 7.98 List	Only 4.85
C-90 UD	2.79	All 8.98 List	Only 5.35
TDK		All 9.98 List	Only 5.85
C-90 SA (Cr)	2.99	Tapes-Cassette or 8-Track add .40	
C-60 SA (Cr)	2.19	Record Orders By Mail Only	
C-90 AD	2.49	No Telephone Orders Accepted	
PHONO CARTRIDGES		CAR STEREO	
Shure V-15 Type IV		PIONEER	
Shure V15 Type III HE	67.99	KPX 9500 Indash	177.99
Shure M97-HE	53.99	KP 8500 Indash	142.99
Shure M95-HE	35.99	KP 8000 Indash	155.99
AT-305 w/AT-630	102.99	KE 5000 Indash	249.99
Audio-Technica AT14-SA	49.99	GM-40 Power Amp	49.99
Audio-Technica AT12-SA	35.99	GM-120 Power Amp	107.99
Stanton 8815	77.99	SANYO	
Stanton 681EEES	56.99	FT 1490-2 Indash	166.99
Stanton 681EEE	47.99	FT 646 Indash	144.99
Empire 2000Z	54.99	FTC 6 Indash	90.99
Empire 2000ES	18.99	JENSEN	
Pickering XSV4000	68.99	R-430 Indash Cassette	329.99
Pickering XSV3000	49.99	R-420 Indash Cassette	269.99
HEADPHONES		R-410 Indash Cassette	209.99
Koss Pro 4AAA	49.99	R-402 Indash Cassette	172.99
Koss HVXLC	48.99	JENSEN SPECIAL	
Sennheiser HD-430	75.99	R-405 Indash Cassette	189.99
Sennheiser HD-420	52.99	BLAUPUNKT	
Audio-Technica ATH-7	99.99	CR 2001 Indash	275.99
		CR 2000D Indash	237.99

FREE CATALOG UPON REQUEST!!

We carry a full line of PIONEER, TECHNICS, AKAI, B.I.C. & TEAC Home Stereo Equipment as well as PIONEER, JENSEN, CLARION, SANYO, BLAUPUNKT, PANASONIC, and CONCORD Car Stereos.

ORDERING INSTRUCTIONS

All merchandise is Factory Fresh and complete with Manufacturer's Warranty. For immediate shipment, send Certified Check, Money Order, Cashier's Check or Master Charge or Visa (Send Card Number and Expiration Date). Call us Toll-Free Mon-Fri 9AM-7PM, Sat 10AM-7PM (Eastern Time) for Credit Card orders. Personal Checks are subject to hold for bank clearance. Shipping and Handling charge \$3.50 (Canada, Puerto Rico, Hawaii, Alaska \$7.00) Allow 5-12 days for U.P.S. delivery. For all matters other than to place orders please call us at 212-686-5500. No C.O.D. orders accepted. NY residents must include Sales Tax.

Automatic Electronics
CALL TOLL-FREE 800-223-2706
In N.Y., Hawaii, Alaska, Puerto Rico, Canada Call (212) 686-5500
CIRCLE NO. 5 ON FREE INFORMATION CARD

CALCULATOR SPECIALS

HEWLETT-PACKARD

Model	Your Cost
HP-31E Scien	\$ 44.95
HP-32E Scien	58.95
HP-33E Prog	72.95
HP-33C Prog	94.95
HP-34C Prog	124.95
HP-37E Finan	62.95
HP-38E Finan	104.95
HP-38C Finan	124.95
HP-67 Prog	259.95
HP-92 Finan	399.95
HP-97 Prog	579.95
HP-41C Prog	259.95
Card Reader/41C	189.95
Printer 41C	364.95
HP-85 Computer	CALL

TEXAS INSTRUMENTS

Model	Price	Model	Price
TI-30SP	\$16.95	TI-57	\$49.95
TI-35	\$22.95	TI-58C	\$9.95
TI-55	\$34.95	TI-59	\$209.95
TI Translator	\$199.95	Thermostat	\$99.95
Speak & Spell	\$59.95	Chrono alarm	\$34.95
Craig Translator	\$149.95	Casio ML-90	\$44.95
Sharp EL-5100	\$74.95	Sharp EL-6200	\$84.95

SEIKO SPECIALS In stainless steel

Model	Price	Model	Price
Chronograph	\$ 79.95	Alarm	\$ 79.95
Multialm gldtne	139.95	Alm chr cntdn	124.95
Solar alm chr	149.95	Music alm chr	139.95
World time alarm	149.95	Calculator alarm	149.95
Digital analog	129.95	Mem bank calndr	99.95

For faster delivery use cashiers check or money order. Add shipping: 1% for order (\$2.50 min.) East of Miss. Riv add \$1.00. CA res add 6%. Subject to availability.

Order Outside
Toll-free 800-421-5188 CA, AK, HI

For technical information call (213) 633-3262

tam's
INCORPORATED

Tam's Dept. PE9
14932 Garfield Av
Paramount, CA 90723
(213) 633-3262

CIRCLE NO. 74 ON FREE INFORMATION CARD

OPERATION ASSIST cont'd

Burroughs model #B-9352, serial #A-60203 CRT terminal. Need user and maintenance manuals. Larry L. Hoglin, 5624 Morgan Ave. So., Minneapolis, MN 55419.

Radio Shack model #STA-76 AM/FM stereo receiver. Need schematic. Luis Rullan Castillo, Buzon 656 El Quenepo, Quebrada Grande, Mayaguez, PR 00708.

Micro Match model #263.11 watt meter. Need repair/service manuals and schematics. Nick Marsala, AB5M, 5339 East 97th Street South, Tulsa, OK 74136.

Accurate Instrument Co., Inc., model 157 tube tester. Need operation manual and set up charts. Harvey Wells bandmaster Z match. Need calibration graph. S.A. Schreiber, 2607 Meadow Lane, La Marque, TX 77568.

Concord model #MK8 8 track recorder. Need service manuals and schematics. Harry F. Robertson, 5309 N.W. 108 Terrace, Oklahoma City, OK 73132.

RCA model 160-B oscilloscope. Need schematic and manuals. Henry M. Cantor, 21 Friendly Court, Babylon, NY 11702.

RCA Victor model R-4 radio. Need service data, tubes and dial parts. Len Powell, 1800 Crestview Rd., Baltimore, MD 21239.

Superior Instrument Co., model 670-A multimeter. Need manuals. Merle W. McMahon, 3327 S. Northern Blvd., Independence, MO 64052.

Electronic Measurements Corp., model 300 VTVM and Precision Apparatus Co., model E-200 signal generator. Need schematics and owner's manuals. Louis D. Antuono, Saint John's University Amateur Radio Club, Jamaica, NY 11439.

Sound City model 200 guitar amplifier. Need schematic. Tony Fox, 8460 Narrow Gauge Road, Beulah, MI 49617.

Technical Material Corp., model MSR 4 mode selector receiver and Allen B. Dumont Laboratories, Inc., cathode ray oscillograph model 224-A. Need operation and service manuals. Paul C. Gunn, 1396 South Fourth St., Aurora, IL 60538.

Motorola model 41E radio. Need schematic. B. Grimes, Rt. 1, Box 2006, Ft. McCoy, FL 32637.

Sylvania type 400 television oscilloscope and Akai 3000 D tape recorder. Need manuals and schematics. Leo P. Stone, R.D. #4, Bath, NY 14810.

Hewlett-Packard model 400C generator. Need schematic. M.D. Chedester, 2507 SE 20th Pl, Cape Coral, FL 33904.

Knight Kit star roamer II short wave receiver. Need schematic and/or assembly manual. R. Tomeo, Box 2362, San Diego, CA 92112.

Facit Electronic type 1121 #103.469 calculator. Need operator and maintenance manual. E.P. Eardley, 4002 Rose Lane, Annandale, VA 22003.

Tektronix type 531 oscilloscope. Need manual or schematic. Ross Hansohn, 841 E. Sheridan, Phoenix, AZ 85006.

Sonar model H tube type CB transceiver. Need schematic, alignment procedure and parts source. Douglas Weeks, 1617 Maurice St., Monroe, NC 28110.

Tektronix model 533 oscilloscope. Need schematic and operation manual. Ernest Koenderink, 9 Begonia St., 2565 SP The Hague, Netherlands.

Dressen Barnes model 1K-500B power supply. Need service information. J.A. Call, 1876 E. 2990 S., Salt Lake City, UT 84106.

Knight Electronics model KG-415 tape deck. Need assembly manual, schematics or any available information. David Taylor, 2179 Lake Village Dr., Kingwood, TX 77339.

Solar model CE-2U capacity analyzer. Need schematic and operating instructions. R. J. Seyler, 312-186 Edinburgh Rd., Guelph, Canada NIG 2H9.

Furat Electronics model 115R.A. wow meter, Waveforms model 452A transmission measuring set, and Ballantine model 300 and 305 ac voltmeters. Need schematics and operating manuals. Ken DeGruchy, 281 Eastbrook Rd., Ridgewood, NJ 07450.

Bell Sound Systems, Inc. model #2254 FM tuner and model #2256 amplifier. Need schematics and service manuals. F. Lee Moratzka, Box 725, Hoffman Estates, IL 60195.

Put Professional Knowledge and a COLLEGE DEGREE in your Electronics Career through HOME STUDY

Earn Your DEGREE

No commuting to class. Study at your own pace, while continuing your present job. The Grantham home-study program leads first to the A.S.E.T. and then to the B.S.E.T. degree. Our free bulletin gives full details. Write for *Bulletin ET-80*.

Grantham College of Engineering
2500 So. LaCienega Blvd.
Los Angeles, California 90034

GRANTHAM'S FCC LICENSE STUDY GUIDE—377 pages, 16 FCC-type practice tests, 1465 questions with answers and discussions—covering third, second, and first class radiotelephone license exams. Preparation for each separate class of license is presented in a separate section of the book. \$15.75 postpaid. Order from:

GSE Publications
P. O. Box 35499, Los Angeles, Calif. 90035

Make up to \$12⁵⁰ an hour

Start your own money making business!

Be Your Own Boss!

YOU Can Do It Too!

BE A LOCKSMITH

Never before have money-making opportunities been so great for qualified Locksmiths. Now lucrative regular lock and key business has multiplied a thousandfold as millions seek more protection against zooming crime. Yet there's only one Locksmith for every 17,000 people!

Train FAST at Home—Collect CASH PROFITS Right Away. You're "in business" ready to earn up to \$12.50 an hour a few days after you begin Belsaw's shortcut training. Take advantage of today's unprecedented opportunities in Locksmithing for year-round EXTRA INCOME in spare-time—or fulltime in a high-profit business of your own. Hundreds were trained have done it. So can YOU! All tools plus professional Key Machine given you with course. These plus practice materials and equipment, plus simple, illustrated lessons, plus expert supervision, plus business-building guidance will enable you to KEEP THE MONEY COMING IN! Ideal for retirement—good jobs too. SEND FOR EXCITING FACTS—No Obligation! ALL SPECIAL TOOLS AND EQUIPMENT INCLUDED!

PRO KEY MACHINE YOURS TO KEEP! This Pro Key Machine can alone add up to \$200 a month to your income... and I won't cost you a penny extra with your training. Find out all about it! **RUSH COUPON!**

RUSH Send for your COUPON! copy today!

Accredited Member National Home Study Council

10-DAY NO RISK TRIAL! BELSAW INSTITUTE

1066 Field Bldg. Kansas City, MO. 64111

There is NO OBLIGATION and NO SALESMAN Will Call—ever!

FREE! BELSAW INSTITUTE
1066 Field Bldg., Kansas City, Mo. 64111
Please rush FREE Book "Keys to your Future."

NAME _____

Tells how to make money in Locksmithing almost from the start! CITY-STATE-ZIP _____

CIRCLE NO. 9 ON FREE INFORMATION CARD

PROJECT OF THE MONTH

X100 Frequency Multiplier

BY FORREST M. MIMS

LOW-FREQUENCY signals are more difficult to measure than you might think. First of all, you must have a frequency counter whose amplifier has a response that goes far enough down toward dc. Many counters are rated to 50 or 100 Hz, and will display meaningless information when driven by lower-frequency signals. Secondly, no degree of precision can be obtained unless your frequency counter has a gate time of 10 or more seconds. Even a 10-second gate time gives an accuracy of only one decimal place (0.1 Hz). To make matters worse, a 10-second gate time means that the display is updated only six times a minute. This can make critical circuit adjustments tedious.

Figure 1 shows schematically a simple but very useful $\times 100$ frequency multiplier or *prescaler*. This device dramatically simplifies low-frequency measurements by inserting a divide-by-100 counter between the vco and the wideband phase comparator of a CMOS 4046 phase-locked loop. With the component values shown, the circuit will multiply signals at frequencies ranging from less than one to a

few hundred hertz up to a range that even counters with relatively restricted low-frequency responses can accommodate.

In operation, properly conditioned pulses are applied to the input of the 4046. The loop generates an error voltage which is filtered and applied to the input of the vco, thus beginning the capture process. Because a divide-by-100 counter is placed between the output of the vco and the phase comparator's second input, the vco frequency will be exactly 100 times that of the input signal when the loop is phase-locked. The signal frequency can then be measured to an accuracy of one decimal place (0.1-Hz resolution) with a standard frequency counter having a one-second gate time.

The capture time of this phase-locked loop prescaler can easily exceed several seconds, especially when very low frequencies are applied to its input. If you intend to use the circuit to measure frequencies consistently higher than 50 Hz, you can speed up the loop's capture time by reducing the value of C2 to 0.22 μ F.

If the signals to be multiplied are

noisy or have slow rise and fall times, it will be necessary to condition them before they are applied to the input of the 4046. Figure 2 shows a simple snap-action comparator made from a BiMOS CA3130 op amp that can be used for this purpose. This circuit can process signals with frequencies as high as 50 kHz. Other op amp types can be used in place of the CA3130.

In Fig. 1, a 4518 is used as a divide-by-100 counter. This IC was selected principally because it includes two decade counters in a single DIP, but other counter arrangements can also be used. A pair of 4017 decade counters, for example, can be cascaded to form a suitable divide-by-100 counter.

Applications for this month's project are plentiful because the circuit can be used to multiply virtually any low-frequency signal. Of particular interest is the measurement of such low-frequency biological signals as brain waves and cardiac-pulse, respiration and blink rates. Other possibilities include measuring the revolution rates of wind turbines, bicycle wheels and low-speed motors. \diamond

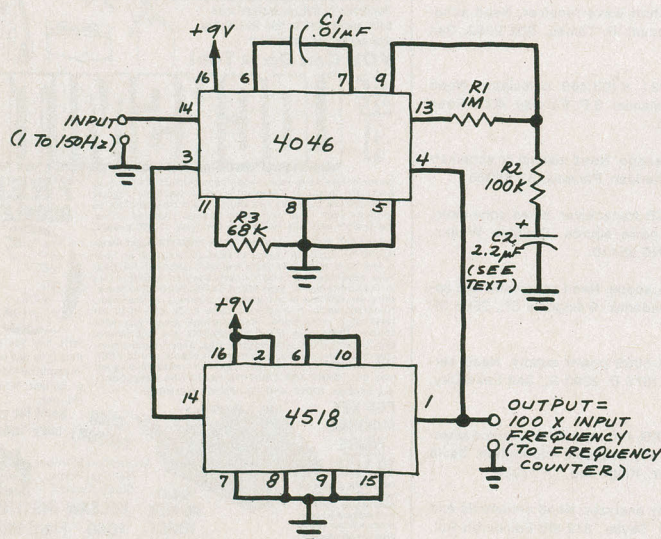


Fig. 1. A X100 prescaler for low-frequency measurements.

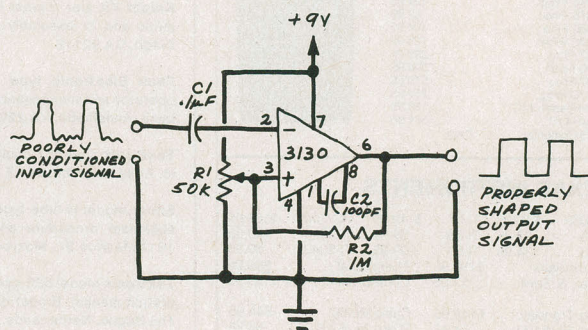


Fig. 2. A snap-action comparator made from a BiMOS op amp that can be used as a pulse shaper.

DIG-KEY TOLL FREE CORPORATION

Quality Electronic Components

DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

TEXAS INSTRUMENTS I.C. SOCKETS

SOLDER TAIL DIP SOCKETS

- Low profile
- Peak grid design for maximum retention force
- Your choice - "TIN OR GOLD"
- Redundant contact design
- Minimum of 10 microinch gold plating on gold sockets

TIN INLAY SOLDER TAIL

Part No.	Description	10	100
C508	8 pin solder tail, tin	10	8.00
C514	14 pin solder tail, tin	17	15.14
C516	16 pin solder tail, tin	20	17.60
C518	18 pin solder tail, tin	22	19.80
C520	20 pin solder tail, tin	25	22.00
C522	22 pin solder tail, tin	27	24.30
C524	24 pin solder tail, tin	30	26.60
C526	26 pin solder tail, tin	33	28.90
C528	28 pin solder tail, tin	35	31.10
C530	30 pin solder tail, tin	38	33.40

GOLD INLAY SOLDER TAIL

Part No.	Description	10	100
C508	8 pin solder tail, gold	28	24.00
C514	14 pin solder tail, gold	37	32.00
C516	16 pin solder tail, gold	42	36.00
C518	18 pin solder tail, gold	47	40.00
C520	20 pin solder tail, gold	52	44.00
C522	22 pin solder tail, gold	57	48.00
C524	24 pin solder tail, gold	62	52.00
C526	26 pin solder tail, gold	67	56.00
C528	28 pin solder tail, gold	72	60.00
C530	30 pin solder tail, gold	77	64.00

WIRE WRAP DIP SOCKETS

- Standard profile
- Universal wire wrap
- Predefined capabilities
- Through accommodate .015" thru .020" rectangular
- or round dual in-line leads
- Wire wrap design to true position of .015" providing a true position of .020" for efficient automatic wire wrapping

"YOUR CHOICE - TIN OR GOLD"

- Minimum 10 microinch gold plating on gold sockets
- TEXAS INSTRUMENTS QUALITY

TIN PLATED WIRE WRAP

Part No.	Description	10	100
C310	8 pin wire wrap, tin	32	29.00
C316	14 pin wire wrap, tin	42	39.00
C318	16 pin wire wrap, tin	47	43.00
C320	18 pin wire wrap, tin	52	47.00
C322	20 pin wire wrap, tin	57	51.00
C324	22 pin wire wrap, tin	62	55.00
C326	24 pin wire wrap, tin	67	59.00
C328	26 pin wire wrap, tin	72	63.00
C330	28 pin wire wrap, tin	77	67.00
C332	30 pin wire wrap, tin	82	71.00

GOLD INLAY WIRE WRAP

Part No.	Description	10	100
C310	8 pin wire wrap, gold	49	43.15
C316	14 pin wire wrap, gold	62	54.95
C318	16 pin wire wrap, gold	67	59.95
C320	18 pin wire wrap, gold	72	64.95
C322	20 pin wire wrap, gold	77	69.95
C324	22 pin wire wrap, gold	82	74.95
C326	24 pin wire wrap, gold	87	79.95
C328	26 pin wire wrap, gold	92	84.95
C330	28 pin wire wrap, gold	97	89.95
C332	30 pin wire wrap, gold	102	94.95

MOLEX I.C. SOCKET PINS

Part No.	Description	10	100
C508	8 pin wire wrap, tin	32	29.00
C514	14 pin wire wrap, tin	42	39.00
C516	16 pin wire wrap, tin	47	43.00
C518	18 pin wire wrap, tin	52	47.00
C520	20 pin wire wrap, tin	57	51.00
C522	22 pin wire wrap, tin	62	55.00
C524	24 pin wire wrap, tin	67	59.00
C526	26 pin wire wrap, tin	72	63.00
C528	28 pin wire wrap, tin	77	67.00
C530	30 pin wire wrap, tin	82	71.00

TEXAS INSTRUMENTS GOLD EDGEBOARD CONNECTORS

- Predefined, controlled spring design
- Contacts are user removable
- NOTE - Dimensions shown are pin center to center measurement

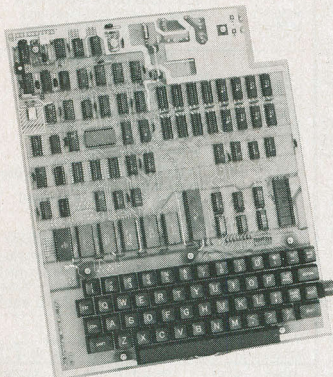
H4 SERIES - .125" x .250" EDGEBOARD CONNECTORS

Part No.	Description	10	100
10720	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10722	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10724	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10726	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10728	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10730	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10732	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10734	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10736	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10738	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10740	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10742	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10744	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10746	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10748	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10750	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10752	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10754	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10756	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10758	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10760	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10762	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10764	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10766	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10768	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10770	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10772	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10774	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10776	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10778	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10780	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10782	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10784	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10786	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10788	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10790	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10792	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10794	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10796	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10798	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10800	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10802	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10804	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10806	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10808	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10810	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10812	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10814	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10816	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10818	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10820	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10822	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10824	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10826	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10828	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10830	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10832	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10834	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10836	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10838	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10840	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10842	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10844	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10846	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10848	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10850	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10852	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10854	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10856	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10858	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10860	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10862	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10864	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10866	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10868	C-15 2.22 20.00 18.00	C-15 2.10 19.00 18.00	
10870	C-15 2.22 20.00 18.00	C-15 2.10 19.00	

**SUMMER
SALE!**

**Now a complete OHIO SCIENTIFIC
mini-floppy system for just \$797!**

Here's what you get:



Ohio Scientific Superboard II

The first complete computer system on a board! Includes keyboard, video interface and audio cassette interface. 8K BASIC-in-ROM, 4K RAM.

Requires power supply of +5V @ 3 amps

\$299

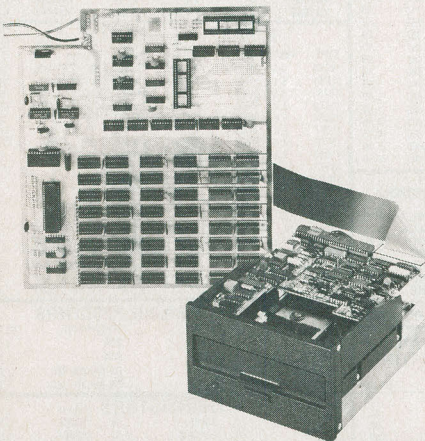
"We heartily recommend Superboard II for the beginner who wants to get into microcomputers with a minimum cost. A real computer with full expandability."

—POPULAR ELECTRONICS, MARCH, 1979

"The Superboard II is an excellent choice for the personal computer enthusiast on a budget."

—BYTE, MAY, 1979

Buy OHIO SCIENTIFIC's 610 Expander Board and get \$99 off reg. \$299 price of mini-floppy disk drive (including connector cable). ONLY \$200!



610 Expander Board

For use with Superboard II and Challenger 1P. 8K static RAM expandable to 24K or 32K system total. Accepts up to two mini-floppy disk drives.

Requires +5V @ 4.5 amps

\$298

Mini-Floppy Disk Drive

Includes Ohio Scientific's PICO DOS software and connector cable. Compatible with 610 Expander Board.

Requires +12V @ 1.5 amps and +5V @ 0.7 amps.

Reg. \$299

SALE! \$200

TOTAL \$797

4KP 4K RAM chip set	\$ 79
PS003 Mini-floppy power supply	each \$ 29
PS005 5V 4.5 amp open frame power supply	\$ 35
SAMS manual C1P/Superboard II	\$ 8
SAMS manual C4P	\$ 16
OS-65D V3.2 Disk Operating System with 9-digit extended BASIC, random access from sequential files	\$ 49
C4P computer 8K RAM expandable to 32K RAM	\$ 750
C4P MF computer Mini-floppy, 24K RAM	\$1795
C8P computer 8K RAM expandable to 32K and dual 8-inch floppies	\$ 950
C8P DF computer 32K RAM expandable to 48K, dual 8-inch floppies	\$2895

NEW! SAMS manual for the Challenger III Series **\$ 40**

Attention Superboard II and C1P owners:

You can still take advantage of our summer sale. Purchase the 610 Expander Board for the regular price and get \$99 off on the mini-floppy and cable.

Step up to mini-floppy operation for only \$498.

COMING SOON! Color Video Adaptor for Superboard II and C1P!

Freight Policies

All orders of \$100 or more are shipped freight prepaid. Orders of less than \$100 please add \$4.00 to cover shipping costs. Ohio Residents add 5.5% Sales Tax.

Guaranteed Shipment

Cleveland Consumer Computers & Components guarantees shipment of computer systems within 48 hours upon receipt of your order. **Our failure to ship within 48 hours entitles you to \$35 of software, FREE.**

To Order:

Or to get our free catalog

CALL 1-800-321-5805 TOLL FREE.

Charge your order to your **VISA** or **MASTER CHARGE** ACCOUNT Ohio Residents Call: (216) 464-8047. Or write, including your check or money order, to the address listed below.



Hours:

Call Monday thru Friday 8:00 AM to 5:00 PM E.D.T.



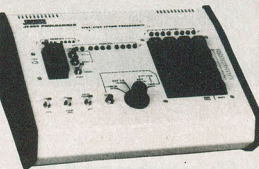
**CLEVELAND CONSUMER
COMPUTERS & COMPONENTS**
P.O. Box 46627
Cleveland, Ohio 44146

**TO ORDER: CALL
1-800-321-5805
TOLL FREE**

7400 TTL			7400 TTL		
SN7400N	.20	SN7400N	.29	SN74160N	.89
SN7401N	.20	SN7401N	.29	SN74161N	.89
SN7402N	.20	SN7402N	.29	SN74162N	.89
SN7403N	.20	SN7403N	.29	SN74163N	.89
SN7404N	.25	SN7404N	5.00	SN74164N	.89
SN7405N	.20	SN7405N	.29	SN74165N	.89
SN7406N	.25	SN7406N	.29	SN74166N	1.25
SN7407N	.29	SN7407N	.69	SN74167N	1.95
SN7408N	.20	SN7408N	.39	SN74168N	1.59
SN7409N	.20	SN7409N	.39	SN74169N	1.59
SN7410N	.18	SN7410N	1.75	SN74170N	1.25
SN7411N	.25	SN7411N	.29	SN74171N	1.00
SN7412N	.25	SN7412N	.29	SN74172N	1.00
SN7413N	.25	SN7413N	.29	SN74173N	1.00
SN7414N	.70	SN7414N	.43	SN74174N	.79
SN7415N	.70	SN7415N	.43	SN74175N	.79
SN7416N	.25	SN7416N	.65	SN74176N	.79
SN7417N	.25	SN7417N	.65	SN74177N	.79
SN7418N	.25	SN7418N	.65	SN74178N	.79
SN7419N	.25	SN7419N	.65	SN74179N	.79
SN7420N	.25	SN7420N	.65	SN74180N	.79
SN7421N	.25	SN7421N	.65	SN74181N	.79
SN7422N	.39	SN7422N	3.00	SN74182N	.79
SN7423N	.25	SN7423N	1.25	SN74183N	.79
SN7424N	.25	SN7424N	1.25	SN74184N	.79
SN7425N	.25	SN7425N	1.25	SN74185N	.79
SN7426N	.25	SN7426N	1.25	SN74186N	.79
SN7427N	.25	SN7427N	1.25	SN74187N	.79
SN7428N	.25	SN7428N	1.25	SN74188N	.79
SN7429N	.25	SN7429N	1.25	SN74189N	.79
SN7430N	.25	SN7430N	1.25	SN74190N	.79
SN7431N	.25	SN7431N	1.25	SN74191N	.79
SN7432N	.25	SN7432N	1.25	SN74192N	.79
SN7433N	.25	SN7433N	1.25	SN74193N	.79
SN7434N	.25	SN7434N	1.25	SN74194N	.79
SN7435N	.25	SN7435N	1.25	SN74195N	.79
SN7436N	.25	SN7436N	1.25	SN74196N	.79
SN7437N	.25	SN7437N	1.25	SN74197N	.79
SN7438N	.25	SN7438N	1.25	SN74198N	.79
SN7439N	.25	SN7439N	1.25	SN74199N	.79
SN7440N	.25	SN7440N	1.25	SN74200N	.79
SN7441N	.25	SN7441N	1.25	SN74201N	.79
SN7442N	.25	SN7442N	1.25	SN74202N	.79
SN7443N	.25	SN7443N	1.25	SN74203N	.79
SN7444N	.25	SN7444N	1.25	SN74204N	.79
SN7445N	.25	SN7445N	1.25	SN74205N	.79
SN7446N	.25	SN7446N	1.25	SN74206N	.79
SN7447N	.25	SN7447N	1.25	SN74207N	.79
SN7448N	.25	SN7448N	1.25	SN74208N	.79
SN7449N	.25	SN7449N	1.25	SN74209N	.79
SN7450N	.25	SN7450N	1.25	SN74210N	.79
SN7451N	.25	SN7451N	1.25	SN74211N	.79
SN7452N	.25	SN7452N	1.25	SN74212N	.79
SN7453N	.25	SN7453N	1.25	SN74213N	.79
SN7454N	.25	SN7454N	1.25	SN74214N	.79
SN7455N	.25	SN7455N	1.25	SN74215N	.79
SN7456N	.25	SN7456N	1.25	SN74216N	.79
SN7457N	.25	SN7457N	1.25	SN74217N	.79
SN7458N	.25	SN7458N	1.25	SN74218N	.79
SN7459N	.25	SN7459N	1.25	SN74219N	.79
SN7460N	.25	SN7460N	1.25	SN74220N	.79

JE608 PROGRAMMER

2704/2708 EPROM PROGRAMMER



JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operation. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuit. This will allow the user to test or pretest a program, for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board with 25 IC's and including power supplies of: -5V, +5V, +12V and +20V. The Hexadecimal Keyboard and LED/TEST/Chip Board are separate assemblies within the system.

JE608 KIT \$399.95
JE608 Assembled and Tested \$499.95

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/1		

DISCRETE LEDS

XC56R .200" red 5/1	MV50 .085" red 6/1	XC11R .190" red 5/1
XC56G .200" green 4/1	XC209 .125" red 5/1	XC11G .190" green 4/1
XC56Y .200" yellow 4/1	XC209 .125" green 4/1	XC11Y .190" yellow 4/1
XC56C .200" clear 4/1	XC209 .125" yellow 4/1	XC11C .190" clear 4/1
XC22R .200" red 4/1	XC56G .185" red 4/1	
XC22G .200" green 4/1	XC56G .185" green 4/1	
XC22Y .200" yellow 4/1	XC56G .185" yellow 4/1	
XC22C .200" clear 4/1	XC56G .185" clear 4/1	
MV10B .170" red 4/		

new
**ULTRAVIOLET
INTENSITY
METER**
by BLAK-RAY

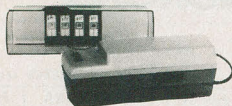


TWO MODELS:
LONG WAVE
AND
SHORT WAVE

Meter consists of a sensor cell attached to a compact (3" x 3 1/4" x 3") metering unit. Can be hand-held or placed directly on surface for measuring. Can be used remotely, while connected to a meter housing by a 4-foot extension cord. Two models available — one for long wave and one for short wave ultraviolet. Readings are in microwatts per square centimeter. Weight: 1 lb.

Completely assembled (includes sensor cell, reduction screen, extension cord, contrast filter and certification report.)
J-221 LONG WAVE
(300nm-400nm) **\$242.00**
J-225 SHORT WAVE
(200nm-280nm) **\$260.00**

EPROM Erasing Lamp



- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes
- Maintains constant exposure distance of one inch
- Special conductive foam liner eliminates static build-up
- Built-in safety lock to prevent UV exposure
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips

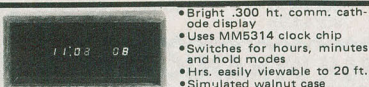
UVS-11E **\$69.95**

Jumbo 6-Digit Clock Kit



- * Four .630"ht. and two .300"ht. common anode displays
- * Uses MM5314 clock chip
- * Switches for hours, minutes and hold functions
- * Hours easily viewable to 30 feet
- * Simulated walnut case
- * 115VAC operation
- * 12 or 24 hour operation
- * Includes all components, case and wall transformer
- * Size: 6 1/2" x 3 1/2" x 1 1/2"

JE747 **\$29.95**



JE701

6-Digit Clock Kit **\$19.95**

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to +5V, +9V and +12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3 1/2" x 5" x 2" H

JE200 **\$14.95**



ADAPTER BOARD
—Adapts to JE200—
±5V, ±9V and ±12V

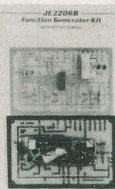
DC/DC converter with +5V input. Toroidal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3 1/2" x 2" x 9/16" H

JE205 **\$12.95**

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES			MICROPROCESSOR MANUALS		
8080A	CPU	\$ 7.95	M-280	User Manual	\$7.50
8212	8-Bit Input/Output	3.25	M-CDP1802	User Manual	7.50
8214	Priority Interrupt Control	5.95	M-2650	User Manual	5.00
8216	Bi-Directional Bus Driver	3.49			
8224	Clock Generator/Driver	3.95			
8226	Bus Driver	3.49			
8228	System Controller/Bus Driver	4.95			
8238	System Controller	5.95			
8251	Prog. Comm. 1/0 (USART)	7.95			
8253	Prog. Interval Timer	14.95			
8255	Prog. Periph. 1/0 (PPI)	9.95			
8257	Prog. DMA Control	19.95			
8259	Prog. Interrupt Control	19.95			
8080/8080 SUPPORT DEVICES			ROM'S		
MC6800	MPU with Clock and Ram	\$14.95	2513(2140)	Character Generator(upper case)	\$9.95
MC6802CP	128X8 Static Ram	24.95	2513(3021)	Character Generator(lower case)	9.95
MC6810API	Periph. Inter. Adapt (MC6820)	7.49	2516	Character Generator	10.95
MC6821	Priority Interrupt Controller	12.95	MMS230N	2048-Bit Read Only Memory	1.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95			
MC6850	Asynchronous Comm. Adapter	21.44			
MC6852	Synchronous Serial Data Adapt.	9.95			
MC6860	0-600 bps Digital MODEM	12.95			
MC6862	2400 bps Modulator	14.95			
MC6880A	Quad 3-State Bus. Trans. (MC8726)	2.25			
MICROPROCESSOR CHIPS—MISCELLANEOUS			RAM'S		
Z80(780C)	CPU	\$13.95	1101	256X1 Static	\$1.49
Z80A(780-1)	CPU	15.95	1103	1024X1 Static	.99
CDP1802	CPU	19.95	2101(8101)	256X4 Static	3.95
2650	MPU	19.95	2102	1024X1 Static	1.75
6502	CPU	11.95	2112	1024X1 Static	1.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95	2114-3	1024X4 Static	3.95
P8085	CPU	19.95	2114-3	1024X4 Static MOS	7.95
TMS990JUL	16-Bit MPU w/hardware, multiply & divide	49.95	2114-3	1024X4 Static 450ns low power	10.95
SHIFT REGISTERS			2114-3	1024X4 Static 300ns low power	11.95
MM500H	Dual 25 Bit Dynamic	\$ 5.50	5101	256X4 Static	7.95
MM503H	Dual 50 Bit Dynamic	.50	5280/2107	4096X1 Dynamic	4.95
MM504H	Dual 16 Bit Static	.50	7489	16X4 Static	1.75
MM506H	Dual 100 Bit Static	.50	74S200	256X4 Static Tristate	4.95
MM510H	Dual 64 Bit Accumulator	.50	UPD414	4K Dynamic 16 pin	4.95
MM510H	500/512 Bit Dynamic	.89	(MK4027)	16K Dynamic 16 pin 250ns	7.95
254AT	1024 Dynamic	3.95	UPD416	16K Dynamic 16 pin 250ns	7.95
2518	Hex 32 Bit Static	2.95	16K	Dynamic 16 pin 250ns	7.95
2522	Dual 132 Bit Static	2.95	TMS4044	4K Static	14.95
2524	512 Static	.99	45N1	45N1 Static	14.95
2525	1024 Dynamic	2.95	TMS4045	1024X4 Static	14.95
2527	Dual 256 Bit Static	2.95	16,384X1	Dynamic 350ns (house marked)	9.95
2528	Dual 250 Static	4.00	MM5262	2KX1 Dynamic	4/1.00
2529	Dual 240 Bit Static	4.00	1702A	2048 FAMOS	\$5.95
2532	Quad 80 Bit Trist.	2.95	2716INTEL	16K* EPROM	59.95
3341	Fifo	6.95	TMS2516	16K* EPROM	24.95
74LS670	4x4 Register File (TriState)	2.49	(2716)	*Requires single +3V power supply	89.95
UART'S			TMS3532	4KX8 EPROM	10.95
A-Y-5-1013	30K BAUD	5.95	2708	8K EPROM	29.95
			2716 T.1	16K** EPROM	29.95

Function Generator Kit



Provides 3 basic waveforms: sine, triangle and square wave. Freq. range from 1 Hz to 100K Hz. Output amplitude from 0 volts to over 6 volts (peak to peak). Uses a 12V supply or a ±6V split supply. Includes chip, P.C. Board, components & instructions.

JE2206B **\$19.95**

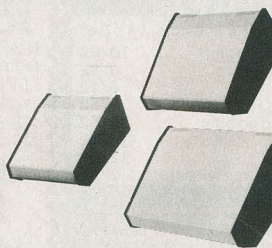
DIGITAL THERMOMETER KIT



- Dual sensors—switching control for indoor/outdoor or dual monitoring
- Continuous LED 8"ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1 nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case - AC wall adapter incl.
- Size: 3-1/4" H x 6-5/8" W x 1-3/8" D

JE300 **\$39.95**

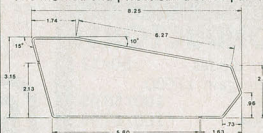
DESIGNERS' SERIES Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top/bottom panels .080 thk. alum. (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:

The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to 1/4" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	\$29.95
DTE-11	10.65"	\$32.95
DTE-14	14.00"	\$34.95

\$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus \$1 Insurance (if desired)

Spec Sheets — 25¢
1980 Catalog Available — Send 41¢ stamp



**Jameco
ELECTRONICS**

PHONE
ORDERS
WELCOME
(415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE

1355 SHOREWAY ROAD, BELMONT, CA 94002

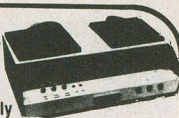
PRICES SUBJECT TO CHANGE

9/80

The Incredible

"Pennywhistle 103"

\$139.95 Kit Only



The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "handing" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate 300 Baud.
Data Format Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies 2025 Hz for space, 2225 Hz for mark.
Transmit Channel Frequencies Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 225 mark.
Receive Sensitivity -46 dbm acoustically coupled.
Transmit Level -15 dbm nominal. Adjustable from -6 dbm to -20 dbm.
Receive Frequency Tolerance Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements 120 VAC, single phase, 10 Watts.
Physical All components mount on a single 5" by 9" printed circuit board. All components included.
Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

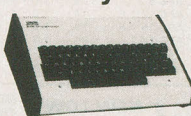
TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.

- * Kit comes complete with:
- * 8 each UPD416-1 (16K Dynamic Rams) * 250NS
- * Documentation for conversion

TRS-16K **\$59.95**

JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and -12V @ 10mA for operation. Features: 60 keys generate the full 128 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for common applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector.

JE610 (Case not included) **\$79.95**

**Desk-Top Enclosure for
JE610 ASCII Encoded Keyboard Kit**
Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3 1/2" H x 14 1/2" W x 8 3/4" D.

DTE-AK **\$49.95**

SPECIAL: JE610/DTE-AK PURCHASED TOGETHER
(Value \$129.90) **\$124.95**

JE600 Hexadecimal Encoder Kit



FULL 8-BIT
LATCHED OUTPUT
19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation.

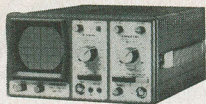
JE600 (Case not included) **\$59.95**

**Desk-Top Enclosure for
JE600 Hexadecimal Keyboard Kit**
Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3 1/2" H x 8 3/4" W x 8 3/4" D.

DTE-HK **\$44.95**

SPECIAL: JE600/DTE-HK PURCHASED TOGETHER
(Value \$104.90) **\$99.95**

NEW PRODUCTS — HAMEG OSCILLOSCOPES

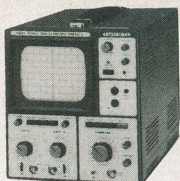


10 Megahertz
HM307
SINGLE TRACE
OSCILLOSCOPE

- IDEAL SERVICE INSTRUMENT
- TIMEBASE 0.2 μ s-0.2 s/cm
- LPS-TRIGGER ■ COMPACT
- BUILT-IN COMPONENT TESTER \$404.25

50 Megahertz
HM812
DUAL TRACE STORAGE
OSCILLOSCOPE

- 50 MHz DUAL TRACE PLUS VARIABLE PERSISTENCE
- DELAYED SWEEP WITH AFTER DELAY TRIGGERING
- STORAGE OF SINGLE-SHOT SIGNALS "AUTOMATIC STORE"
- LED INDICATION FOR OVERSCAN, SINGLE SHOT, TRIGGER ACTION DELAY MODE, AUTOMATIC STORE \$4032.00



20 Megahertz
HM312
DUAL TRACE
OSCILLOSCOPE

- 10 X 8 cm DISPLAY
- LPS-TRIGGERING

- BANDWIDTH DC—20MHz
- TRIGGERING up to 30MHz
- FULL X—Y OPERATION \$609.00

50 Megahertz
HM512
DUAL TRACE
OSCILLOSCOPE

- BANDWIDTH DC—50MHz
- TRIGGERING up to 70MHz
- AFTER TRIGGER DELAY LINE
- SWEEP DELAY
- DELAY LINE
- OVERSCANNING INDICATION
- BRIGHT DISPLAY
- IDEAL FOR COMMUNICATIONS AND DATA PROCESSING \$1485.75



Power Supplies from ADTECH POWER

Model	Vdc	Amps	Model	Vdc	Amps
APS 5-3	5	3.0	APS 5-6	5	6.0
APS 12-1.6	12	1.6	APS 12-4	12	5.0
APS 15-1.5	15	1.5	APS 15-3	15	3.0
APS 24-1	24	1.0	APS 24-2.2	24	2.2
1-9	10 up	25 up	1-9	10 up	25 up
\$42.50	\$40.65	\$38.85	\$66.90	\$64.00	\$61.10

SYM-1 NEW LOW PRICE

\$239.00

KTM-2 CRT/V Kybd Term \$349

FLUKE 8022A \$179

8024A \$219

Intersil LED or LCD 3 1/2 DIGIT PANEL METER KITS

BUILD A WORKING DPM IN 1/2 HOUR WITH THESE COMPLETE EVALUATION KITS

Test these new parts for yourself with Intersil's low cost prototyping kits, complete with A/D converter and LCD display (7106) or LED display (7107). Kits provide all materials, incl PC board, for a functioning panel meter.

- ICL7106V (LCD) \$29.95 ICL7107V (LED) \$24.95
- 8 Digit - 10 MHz Universal Counter Kit**
- Kit Includes:**
 - ICM7226A/DIC IC
 - 10 MHz Quartz Crystal
 - (8) 7 Segment .3" LED Displays
 - PC Board
- Order Part Number ICM7226AEV \$74.95**



Capacitance Meter

- Easy to use—plug in capacitor, push range button and read the value to 0.1%
- 0.5 in. liquid crystal display
- Exclusive "Δcharge/Δvolt" measurement circuit (patent pending) holds $\pm 0.1\%$ basic accuracy for a full year.
- Up to 200 hrs operation on standard 9V Batt.
- 8 easy pushbutton ranges cover 0.1pf to 1999 microfarads.
- Best of all it's easy on the budget - only



MODEL 938 \$179

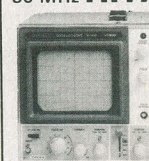
2716 EPROM

- 5 volt 16K \$18.80
- Order 2pcs and Get 5% Discount
- Order 5pcs and Get 10% Discount

LIQUID CRYSTAL DISPLAY

- High Contrast Ratio
- Wide Viewing Angle
- 0.5 in. Digit Height
- ULTRA Low Power Consumption LCD106 \$13.50

30 MHz HITACHI



- Dual Trace Oscilloscope
- TV sync-separator circuit
- High-sensitivity 1mV/div (5MHz)
- Sweep-time magnifier (10 times)
- Z-axis input (Intensity modulation)
- Signal delay line
- X-Y operation
- Trace Rotation \$945.00

More sensitive to your input

HYBRID AUDIO POWER AMPLIFIERS

* Matching Transformer

P/N	SI-1010G(10W)	\$ 6.95	TR10	\$ 7.90
	SI-1020G(20W)	\$13.95	TR20	\$10.90
	A-SI-8(Socket for above)			.95
	SI-1030G(30W)	\$19.00	TR30	\$12.90
	SI-1050G(50W)	\$27.80	TR50	\$17.90
	A-SI-10(Socket for above)			.95

* Note: One Transformer can power two audio amplifiers.

ANCORONA

Send check or Money Order to: P.O. Box 2208Y, Culver City CA 90230

California residents add 6% sales tax. Minimum Order: \$10.00

Add \$1.00 to cover postage and handling. Master Charge and Visa welcomed

Please include your charge card number.

Interbank number and expiration date.

PHONE ORDERS: (213) 641-4064

TUCSON	CULVER CITY	SANTA ANA	PORTLAND
4518 E. Broadway Tucson, AZ 85711 (602) 881-2348	11080 Jefferson Blvd. Culver City, CA 90230 (213) 390-3595	1300 E. Edinger Ave. Santa Ana, CA 92705 (714) 547-8424	1125 N.E. 82nd Ave. Portland, OR 97220 (503) 254-5541
CANADA: B.C. ANCRONA	SUNNYVALE	ATLANTA	HOUSTON
5656 Fraser St. Vancouver, B.C. V6M 2V2 (604) 324-0707	1054 E. El Camino Real Sunnyvale, CA 94087 (408) 243-4121	3330 Piedmont Rd. N.E. Atlanta, GA 30305 (404) 261-7100	2649 Richmond Houston, TX 77068 (713) 529-3489

CIRCLE NO. 3 ON FREE INFORMATION CARD

THESE PRICES ARE NOT MISPRINTS

Here is a chance to stock up your lab at unprecedented prices... we've got to move these out to make room for our ever-expanding CompuPro™ division. **Limited quantities - first come, first served.** Sorry, at these low prices we cannot include spec sheets or accept COD/telephone orders. Part numbers must include the special -S suffix or you will be charged our regular prices. Parts may be house numbered or have dual markings. **This is your chance to save!**

TTL

7403-S	Quad 2 input OC	21/\$2
7410-S	Triple 3 input NAND	21/\$2
7413-S	4 to 16 line decoder/demux	6/\$2
7438-S	Quad 2 input NAND OC	21/\$2
7444-S	Gray to decimal decoder	8/\$2
7450-S	And-or-invert	21/\$2
7472-S	JK M-S flip flop	21/\$2
7493-S	4 bit binary counter	10/\$2
7496-S	5 bit shift register	12/\$2
74122-S	Retriggerable one-shot	18/\$2
74151-S	8 channel mux	8/\$2
74155-S	Dual 2/4 demux	8/\$2
74159-S	4 to 16 line decoder/demux OC	4/\$2
74161-S	Synchro 4 bit binary counter	8/\$2
74163-S	Synchro 4 bit binary counter	8/\$2
74164-S	8 bit shift register	6/\$2
74190-S	Up/down decade counter	4/\$2
74192-S	Up/down binary counter	4/\$2
74194-S	4 bit bidirectional shift reg	4/\$2
74195-S	4 bit parallel shift register	6/\$2
74198-S	8 bit shift register	4/\$2

LINEARS

(package type: H=T099, M=minidip, D=dip, TK=T066)		
201H-S	Improved 301 op amp	10/\$2
308H-S	Micropower op amp	6/\$2
703H-S	RF/IF amp	6/\$2
723D-S	Voltage regulator	6/\$2
741M-S	Compensated op amp	15/\$2
1458M-S	Dual 741	10/\$2
4558M-S	Dual 741	12/\$2
4195TK-S	Dual track 15V reg w/ data	2/\$2

TO-220 NEGATIVE VOLTAGE REGULATORS

7906-S	-6V regulator	2/\$2
7908-S	-8V regulator	2/\$2
7912-S	-12V regulator	2/\$2
7915-S	-15V regulator	2/\$2
7918-S	-18V regulator	2/\$2
7924-S	-24V regulator	2/\$2

OTHER SEMICONDUCTORS

General purpose silicon signal diodes		50/\$2
GT5306 NPN darlington, min gain 17000, 25V 200 mA, T092 package		100/\$8.95
NPN transistor similar 2N3904		100/\$7.95
PNP transistor similar 2N3906		100/\$8.95
4N28-S opto-coupler 6 pin minidip, MCT-2/IL-1 pinout		5/\$2
SN76477-S complex sound generator		1/\$2.50
MA1003 12V DC clock module w/ case		\$19.95
Opto-Isolator Grab Bag - 50 mixed opto-isolators from a major manufacturer. Unmarked 6 and 8 lead minidips include single and dual types with diode, transistor, and darlington outputs. Test them yourself and save! Not recommended for beginners.		50/\$4

CMOS

4012-S	Dual 4 input NAND	12/\$2
4020-S	14 stage counter	4/\$2
4023-S	Triple 3 input NAND	12/\$2
4044-S	Quad R-S latch	4/\$2
4046-S	Phase locked loop	2/\$2
4071-S	Quad 2 input OR	12/\$2
4093-S	Quad 2 in NAND Schmitt trig	4/\$2
4507-S	Quad EX-OR	4/\$2
4510-S	BCD up/down counter	2/\$2
5101-S	1024 bit stat. RAM 4x256	10/\$12.50

SOLDERTAIL SPECIAL!

Now that you've got the ICs, get some sockets at a fantastic price!

14 pin:	50/\$4.95	24 pin:	30/\$4.95
16 pin:	50/\$4.95	28 pin:	30/\$4.95
18 pin:	50/\$4.95	40 pin:	20/\$4.95
20 pin:	40/\$4.95		

16K DYNAMIC RAM SPECIAL ... 8/\$59 !!

Expand memory in TRS-80*-I and -II, as well as machines made by Apple, Exidy, Heath H89, newer PETs, etc. Low power, high speed (4 MHz). Add \$3 for 2 dip shunts plus TRS-80* conversion instructions. **Limited quantity.**

*TRS-80 is a trademark of the Tandy Corporation.

TERMS: Cal res add tax. Allow 5% shipping; excess refunded. Orders under \$15 add \$1 handling. We accept VISA* and Mastercard* orders (\$25 min). Please include street address for UPS delivery. Sale prices good through cover month of magazine; other prices subject to change without notice.

GODBOUT

GODBOUT ELECTRONICS

Bldg. 725, Oakland Airport, CA 94614

FREE CATALOGUE: This is only the tip of the iceberg... we also have power supply kits, MusiKits*, more components, and of course the CompuPro™ series of high-performance S-100 computer boards. For 1st class catalog delivery, add 41 cents in stamps. Foreign orders add \$2 to help cover postage (refundable with order). Thank you for your business!

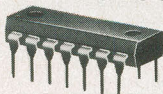
CIRCLE NO. 29 ON FREE INFORMATION CARD

Radio Shack—Your No. 1 Parts Place™

Low Prices and New Items Every Day!

4000-Series CMOS ICs

Low As **89¢**



Type	Cat. No.	Each
4001	276-2401	.99
4011	276-2411	.89
4013	276-2413	1.19
4017	276-2417	1.99
4027	276-2427	1.19
4511	276-2447	1.99
4049	276-2449	.99
4050	276-2450	.99
4066	276-2466	1.59

Schottky ICs

Low As **79¢**

Type	Cat. No.	Each
74LS00	276-1900	.79
74LS02	276-1902	.79
74LS04	276-1904	.79
74LS08	276-1908	.79
74LS32	276-1915	.89
74LS73	276-1918	.99
74LS74	276-1919	.79
74LS75	276-1920	.99
74LS90	276-1923	1.19
74LS123	276-1926	1.49
74LS151	276-1929	1.09
74LS157	276-1930	1.19
74LS161	276-1931	1.59
74LS164	276-1932	1.59
74LS175	276-1934	1.39
74LS193	276-1936	1.69
74LS367	276-1835	1.59

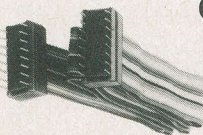
TTL Digital ICs

Low As **69¢**

Type	Cat. No.	Each
7400	276-1801	.69
7402	276-1811	.79
7404	276-1802	.79
7408	276-1822	.79
7447	276-1805	1.19
7448	276-1816	1.29
7473	276-1803	.79
7474	276-1818	.99
7475	276-1806	1.09
7476	276-1813	.89
7490	276-1808	1.09
7492	276-1819	1.19
74154	276-1834	1.49
74192	276-1831	1.59
74193	276-1820	1.49

All 100% Prime from Major Manufacturers. Specs and Pin Out Diagram Included with Each Device.

16-Pin DIP Jumper Cable



3⁹⁹

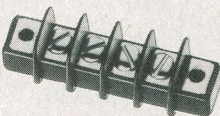
Two 16-pin DIP plugs connected by an 18" color-indexed ribbon cable. Simplifies linking up digital circuits.

276-1976 **3.99**

Barrier Strips

New!

Low As **1¹⁹**



Rugged thermoplastic. Prevent shorts. Ideal for audio equipment, power supplies. Terminals extend 3/16".

Terminals	Cat. No.	Each
4	274-651	1.19
6	274-652	1.49
8	274-653	1.79

Sound Effects Chip



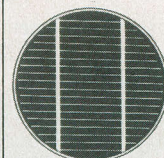
4⁴⁹

28-Pin DIP

SN76477. Music, explosions, phasers, gunshots and more—almost any sound imaginable! Line-level output. 6-15VDC. With data.

276-1765 **4.49**

3" Solar Cell



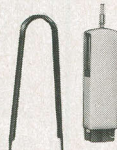
9⁹⁹

High Efficiency

Back in Stock! 0.45V at 1 Amp in full sunlight.

276-123 **9.99**

New! IC Tool Set



6⁹⁵

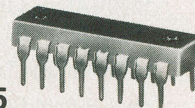
Built-In Pin Straightener

Handy insertion and extraction tools handle all 14 to 16-pin devices. Both tools easily grounded.

276-1574 **Set 6.95**

16K Dynamic RAM

New!



13⁹⁵ Each

16,384 x 1 bits in a 16-pin DIP. Access time: 250 nanoseconds. Refresh: 1 millisecond. Requires +5, +12, and -5VDC. TTL compatible.

276-2505 **13.95**

Mini Lamps New!



Only 99¢

Pkg. of 6

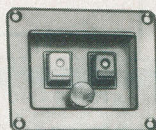
Long life red incandescents for models, charts, dial lights, more. 6V, 60 mA.

272-1144 **6/99¢**

Speaker Terminals

New!

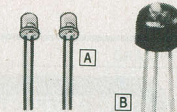
1⁹⁹



Just right for hi-fi, instrument or PA speakers. Push-terminals accept up to 16-ga. wire. Also has 2-conductor 1/4" phone jack with sealing plug.

274-624 **1.99**

Opto Devices



Low As **89¢**

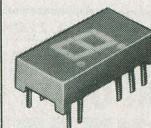
A Emitter/Detector Pair. LED infrared source. Sensitive phototransistor detector.

276-142 **1.99**

B Phototransistor. Sensitive, fast response silicon.

276-130 **.89¢**

Yellow 0.3" LED Readout



New! 1⁹⁹

Pkg. of 2

Right hand decimal, 3.0V/segment @ 20 mA. Common cathode.

276-067 **Pair/1.99**

Cases and Cabinet Save up to 33%



A Deluxe "Wood Look" Cabinet. Metal, slide-off cover, rubber feet. 2 3/4 x 4 1/4 x 5 1/8". **270-262** (Reg. 5.95) **Sale 3.95**

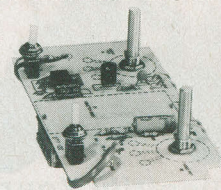
B Readout. Holds four 0.6" or eight 0.3" readouts. Removable bracket. 1 1/2 x 3 3/8 x 4 7/8". **270-285** (Reg. 3.95) **Sale 2.95**

C Clock. For MA-1003 car clock. Blue lens. Accepts 3 switches (not incl.). Bracket, 3 1/2 x 2 1/2 x 2". **270-303** (Reg. 5.95) **Sale 3.95**

TV RF Modulator Board

Save 29%

Reg. 16.95
11⁹⁵



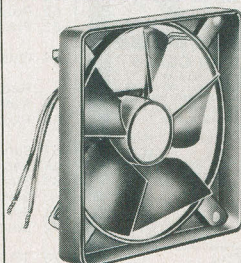
Etched, drilled & labeled PC board with pre-wired RF module and back-of-set ant. switch. Ch. 3 or 4 out. Produces color or b&w video, 30-15,000 Hz hi-fi sound. With instructions. Parts extra.

277-122 **Sale 11.95**

AC Cooling Fan

Quiet, Efficient

14⁹⁵



Ideal for cooling hi-fi and ham equipment, power supplies, computers. 70 CFM. For 120VAC. Just 4.63x4.63x2.47" overall.

273-241 **14.95**

Regulated 12VDC Supply



29⁹⁵

Circuit Breaker Protected

Powers CBs, ham rigs, auto-sound equipment and more from 120VAC. 2.5A continuous, 5A surge, 2 1/2 x 4 1/2 x 6 3/4" U.L. listed.

22-124 **29.95**

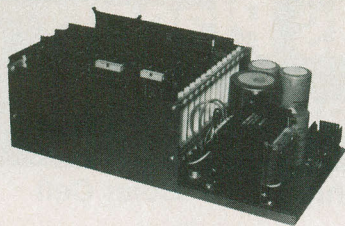
Prices may vary at individual stores and dealers

NEW 1981 Catalog Available Now! Come in for Your FREE Copy! (None Sent by Mail).

Radio Shack®

A DIVISION OF TANDY CORPORATION • FORT WORTH, TEXAS 76102
OVER 7000 LOCATIONS IN 40 COUNTRIES

S-100 S-100 S-100 S-100

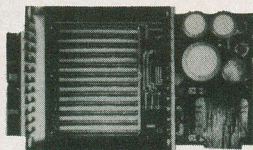
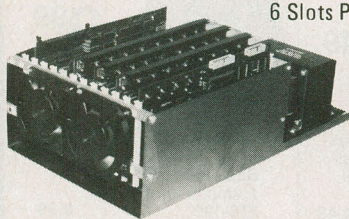


***\$249⁰⁰**

IN STOCK NOW
INTRODUCTORY
OFFER

PLACE QUANTITY
ORDERS NOW,
SAVE!

*Less Boards and Fans, Assembled Add \$45.00,
6 Slots Populated with Connectors



COMPLETE S-100 SYSTEM

ALL NECESSARY
POWER SUPPLIES

*12 Slot Motherboard
Fully Terminated

*30A of +8V
6A of ±16V

*Disc Power Supply
6A of +24V
5A of +5V
1A of -5V

*All Steel Frame

*220VAC or 110VAC
50 or 60 Cycle Operation

*Low Voltage Tap

*Nylon Card Guides

*Connectors Supplied
for up to 4 Drives

*Optional Fans Mount
Neatly on One Side

DELTA PRODUCTS

15392 Assembly Lane, Huntington Beach, CA 92649

(714) 898-1492

CIRCLE NO. 21 ON FREE INFORMATION CARD

For more
information
on
advertised
products,
equipment
tested, etc.,
circle
appropriate
number
on
postpaid
Free
Information
Card.

Popular Electronics

ADVERTISERS INDEX

RS no.	ADVERTISER	PAGE no.
2	All Electronics	123
3	Ancrona Corporation	134
4	Apple Computer	Cover 2, 1
7	AP Products	45
6	Atari	8, 9
5	Audio Matic	127
8	Beckman	6
9	Belsaw Instruments	127
10	B & K Precision	52
	Bullet Electronics	141
11	BYTE	103
12	Chaney Electronics	136
	Classified Advertising	138, 139, 140, 141
13	Chromatronics	123
14	Cleveland Consumer Computer	131
11	Cleveland Institute of Electronics, Inc.	26, 27, 28, 29
1	Communications Electronics	13
15	Components Express, Inc.	121
49	Compuserve	49
16	Computique	96
17	Concord Computer Components	115
18	Cooper Group, The	10
19	CPU Shop	116
20	Creative Computing	122
79	Crown International	14
21	Delta Products	136
22	Digi-Key Corp.	129
23	Discwasher	3, 20
80	EICO	124
24	Electra Co.	24
25	Electronic Technical Institute	105
26	Firestik Antenna Corp.	106
27	General Engines Company	136
28	Gladstone Electronics	44
29	Godbout Electronics, Bill Grantham College of Engineering	134 127
30	Heath Co.	91, 92, 93
31	Heath Co.	72
32	Heath Co.	30
	Heath Co.	60, 61
33	Hewlett-Packard	Cover 3
34	Hobby World	141
35	Home Guardian	120
36	Illinois Audio	122
37	Information Unlimited	106
38	Institute of Audio Research	31
39	Jameco Electronics	132, 133
40	JBL	58
41	J&R Music World	110
	JS & A National Sales Group	7
42	Koss	Cover 4
43	Maxell Corp. of America	95
	MICROCOMPUTER MART	137
44	Media Marketing	75
45	Mercury International	84
46	Mercury International	41
47	Mercury International	104
48	Mercury International	119
	McGraw Hill	54, 55, 56, 57
50	McIntosh Laboratory, Inc.	118
51	Nabih's	123
52	National Guard	37, 38, 39
	National Technical Schools	80, 81, 82, 83
	Netronics R & D Ltd.	47, 109, 117
	NRI Schools	16, 17, 18, 19
	OK Machine & Tool Corp.	71
54	Olympic Sales	141
55	On Computing	111
56	PAIA Electronics, Inc.	96
57	58, 59, 60 Percom Data	2
61	Personal Computer Systems	137
62	Poly Paks	124
63	Protecto	106
64	Quest Electronics	130
	Radio Shack	135
65	Riehl Time Corp.	113
66	Roy Thomas Associates	51
67	Sansui	23
68	Shure Bros.	67
69	Sinclair Electronics	97
	Sinclair Ltd.	53
71	Sony	32, 33
72	Soundguard	34
73	TAB Books	107
74	Tam's Inc.	127
75	The Software Exchange	122
76	Vector Electronics	115
77	Video Club of America	5
78	Yamaha	15

POPULAR ELECTRONICS

BEAT HIGH GAS PRICES!



FREE
Booklet

Electrify Your Bike!

PEDALPOWER exciting new bike drive tames tough hills. Be independent. Shop when you want. Fits all Bikes, Adult Trikes. Installs in minutes. Thousands sold. Recharges overnight. Travels 100 miles for a dime. Get your exercise without strain. Pedal easily with motor engaged to help improve your health. Visit friends. Travel to work or ride for fun. Starts without pedaling. Noiseless, nonpolluting. Virtually maintenance-free operation!

CALL TOLL FREE
800-257-7955*

For Free Booklet and Special Offer or write:
General Engines Co.
5959 Mantua Blvd. Sewell, NJ 08080

* In AK, HI, NJ call collect (609) 468-0270



CIRCLE NO. 27 ON FREE INFORMATION CARD

SOUND EFFECTS GENERATOR BASIC KIT

NOW CHANEY ELECTRONICS MAKES IT POSSIBLE TO BUILD YOUR OWN SOUND EFFECTS GENERATOR WITHOUT SPENDING A FORTUNE. WE SUPPLY YOU WITH THE T176W77 SOUND CHIP PLUS AN ETCHED AND DRILLED GLASS EPOXY PC BOARD WITH SCHEMATIC AND LAYOUT INSTRUCTIONS. THIS BOARD MAKES IT SIMPLE TO BUILD A GENERATOR CAPABLE OF MAKING SOUNDS, LOCOMOTIVE, SIRENS, AIRPLANES, CLOCKS, ETC. DOES NOT REQUIRE DIP SWITCHES OR OTHER EXPENSIVE/UNUSUAL COMPONENTS. YOU SUPPLY ONLY A FEW STANDARD RESISTORS, CAPACITORS, SWITCHES, POTS, SPEAKER, 2N2222 TRANSISTOR AND 9V BATTERY.

BASIC KIT CONTAINING
T176W77, PC BOARD C28883
AND INSTRUCTIONS ONLY \$5.95

2N2222 TRANSISTOR FOR ABOVE C28884 .39 EACH
IF YOU HAVE ALREADY PURCHASED THE T176W77 CHIP YOU MAY BUY THE PC BOARD AND INSTRUCTIONS ONLY. C28885 \$4.00

Strobe Tube & Trigger

C24081 BRAND NEW 1/7" H LONG FLASH TUBE WITH MATCHING HV TRIGGER TRANSFORMER. 1470V SOLE-REQUIRES 300VDC FOR ELECTRONICS.

\$1.75

LED Flasher Kit

Simple to build kit uses the popular 555 timer IC to alternate flash a red and green LED. Comes complete with all parts, including the PC board. 9V battery not included.

C2387 \$2.49

6VDC Xenon Flasher Kit

Battery operated device emits intense bursts of light at approximately 1/4 sec. repeat rate. Complete with parts & PC board. Less battery. C2390 \$8.00

Digital Counting Module

Made for an electronic clock set. Push button unit flashes for period of time then advances to next number. Operates on 9V battery (not incl.).

\$1.79

120 VAC Xenon Strobe Kit

Complete variable rate strobe light kit. Contains all parts, PC board, line cord and instructions.

C23071 \$7.50

Wheel of Fortune

Popular game device uses LED's, transistors & IC's to give the effect of a bright red ball spinning around numbers. Unit emits sound as ball spins & flashes lights on a number. Incl. all parts. Features & PC board. C2306 \$8.99

HIGH OUTPUT SILICON SOLAR CELLS

WE NOW STOCK A FULL LINE OF THESE HARD TO FIND CELLS WHICH CONVERT LIGHT DIRECTLY INTO ELECTRICITY. EACH CELL GENERATES APPROXIMATELY .45 VOLT AND GENERATES CURRENT AS SHOWN BELOW. CONNECT CELLS IN SERIES FOR MORE VOLTAGE AND CONNECT CELLS IN PARALLEL FOR MORE CURRENT. MANY OTHER TYPES ARE LISTED IN OUR CATALOG!

SIZE	CURRENT	STOCK #	PRICE
2" 1/4 CELL	100mA	C24154	\$1.75
2" 1/2 CELL	250mA	C24155	\$3.00
2" WHOLE CELL	500mA	C24156	\$5.50
3" 1/3 CELL	300mA	C24157	\$3.25
3" 1/2 CELL	500mA	C24158	\$5.50
3" WHOLE CELL	750mA	C24159	\$8.50
4" WHOLE CELL	1.3 AMPS	C24160	\$10.00

RECHARGEABLE AA NICKADS
USED-EXCELLENT CONDITION C24161 79¢

CHANEY electronics inc.
P.O. BOX 27038, DENVER, CO. 80227 (303) 781-5750

Send for our free giant catalog of unique items!!!
• Minimum order \$5.00
• Please include \$1.00 for postage
• Visa, MC and COD accepted
• Phone orders are welcome

CIRCLE NO. 12 ON FREE INFORMATION CARD

THE MICROCOMPUTER MART

COMPUTER RETAIL STORES

MICROCOMPUTER MART RATE: 1" x 1 Col. (1-5/8") \$125. 1-1/2" x 1 Col. (1-5/8") \$187.50. 2" x 1 Col. (1-5/8") \$250.00. Send order and remittance to MicroComputerMart, POPULAR ELECTRONICS, One Park Avenue, New York, NY 10016. Direct inquiries to (212) 725-3485.

ILLINOIS



FARNSWORTH COMPUTER

Apple, Hewlett-Packard,
Cromemco, North Star.
(Check our prices)
1891 N. Farnsworth Ave.
Aurora, IL 60505
(312) 851-3888

GEORGIA

AUTHORIZED TRS-80® DEALER A301

COMPUTER SPECIALISTS



Up to
15% Discount
on TRS-80's

26-1051 4K LEVEL I.....\$424.00
26-1056 16K LEVEL II.....\$715.00

1-800-841-0860 TOLL FREE

MICRO MANAGEMENT SYSTEMS, INC.
Downtown Plaza Shopping Center
115 C. Second Ave., S.W.
Cairo, Georgia 31728
(912) 377-7120 Ga. Phone No.

CALIFORNIA

OHIO SCIENTIFIC EXPANSION

The first Book of Ohio Scientific
Volumes 1 & 2 — \$7.95 ea. (188 pages ea.)
Call (Monday - Saturday) or write for free bulletins:

SILVER SPUR ELECTRONIC COMMUNICATIONS

3873-F Schaefer Avenue
Chino, CA 91710 (714) 627-9366
Master Charge/VISA accepted
LARGE SOFTWARE SELECTION

OHIO SCIENTIFIC MICRO-COMPUTERS

A.A. Office
Equipment Company
2140 American Avenue
Hayward, CA 94545
(415) 782-6110

OHIO SCIENTIFIC

Get The Catalog & Our Low Prices
Data Products Maintenance

9460 Telstar
El Monte, CA 91731
(213) 573-5991 (714) 994-4180

HUGE DISCOUNTS

PET-8K — \$778.12 T1 99/4 — \$936.33

HORIZON 1-32K-D-ASM — \$2259.70

DYNABYTE DB 8/2-48 — \$3633.22

Similar Discounts on all Items. Call for Prices.

MICROPROCESSOR APPLICATIONS

P.O. Box 462, Woodacre, CA 94973
(415) 488-0992
VISA - MASTER CHARGE HONORED

FREE! software catalog for Apple II

SALES • SERVICE • LEASING

of
APPLE • ATARI • DEC
Plus all PERIPHERALS & SUPPLIES
Open Tuesday through Sunday
VISA and MASTERCHARGE

RAINBOW COMPUTING, INC.

9719 Reseda Blvd.
Northridge, Ca 91324
(213) 349-5560

MEMOREX DISKETTES

Call toll FREE (800) 235-4137
PACIFIC EXCHANGES

3M DISKETTES

Call toll FREE (800) 235-4137
PACIFIC EXCHANGES

NEW JERSEY

COMPUTER MART OF NEW JERSEY

501 Route 27 Iselin, N.J. 08830

(201) 283-0600



The
Microcomputer
People®

NEW HAMPSHIRE

As advertised in 73 Amateur Radio,
80 Microcomputing &
Kilobaud Microcomputing magazines

COMPUCRUISE

WITH CRUISE CONTROL

Regular list \$199.95 \$159.95

FREE CATALOG shipping & handling

MAIL ORDER MICROS
Dept. P7, 603-924-3041
P.O. Box 427, Marlboro, N.H. 03455



\$669.

Level II, 16K TRS-80

1-800-258-1790

(in. NH call 673-5144)

Send \$1 for our complete catalog:
(\$2 credit on first purchase)

NEW YORK

THE FINEST IN MICROCOMPUTERS

COMPUTER CENTER

31 East 31st Street
New York, NY 10016
(212) 889-8130

GET A GREEN SCREEN

Superb results! Custom molded to fit over the picture tube. Mounts with invisible double-faced tape. Specify TRS-80 Mod. I or II, PET, Leedex 100 or 180, Sanyo 9" or 12".

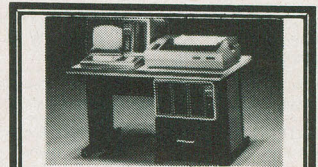
MONEY BACK GUARANTEE!

To order, call (212) 296-5916 or send \$12.50 plus \$2.00 S&H (VISA MC) to:

ALPHA PRODUCTS CO.

85-71 79th St.
Woodhaven, NY 11421

TEXAS



As a Radio Shack® Authorized Sales Center owned & operated by Pan American Electronics, Inc., we can sell them for less. No taxes collected on out-of-state shipments. We pay shipping & insurance.

TOLL FREE 800/531-7466

Texas & Main No.
512/581-2765
1117 Conway
Mission, Texas 78572

LOOK!!

TRS-80® Computer Owners MEGASAVINGS!

* trademark of Tandy Radio Shack Corporation

- Brand new Percom mini-disk systems:
Single-Drive — \$349.95;
Double-Drive — \$699.45;
Triple-Drive — \$1049.45.
- 16K-Byte Memory: 8 prime 4116 ICs — \$64.95

Introductory prices good for a limited time only. Prices do not include shipping, or sales tax if applicable.

CALL Toll-free 1-800-527-4196

ACCESS UNLIMITED

315 N. Shiloh - Ste. D1 - Garland, TX 75042
(214) 494-0208

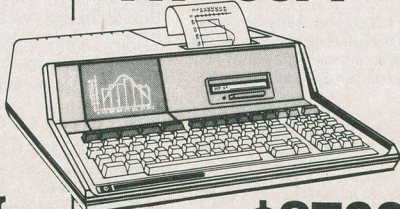
Discount Prices on Personal Computers

Personal
PC computer
Systems



HEWLETT
PACKARD

HP-85A



List \$3250 **\$2799**

609 Butternut Street, Syracuse, N.Y. 13208 (315) 475-6800

Prices do not include shipping by UPS. All prices and offers subject to change without notice.

CIRCLE NO. 61 ON FREE INFORMATION CARD

ATARI® 400, List \$630 ONLY \$499
ATARI® 800, List \$1080 \$849

TI-99/4, List \$1150 ONLY \$995
COMMODORE PET Call us!

CALCULATORS:

HP-41C Calculator, "A System" .. \$244.95
HP-32E Scientific w/Statistics ... \$ 53.95
HP-33C Scientific Programmable ... 99.95
HP-34C Advanced Scientific
Programmable 123.95
HP-37E Business Calculator 58.95
HP-67 Handheld Fully Advanced
Programmable Scientific for
Business & Engineering 298.95
HP-97 Desktop w/Built-in Printer .. 579.95



16K, List \$1195

ONLY \$989



32K, List \$1395 **\$1169**

48K **\$1259**

Electronics Classified

CLASSIFIED RATES: Per Word, 15 Word Minimum. **COMMERCIAL:** \$2.75. **EXPAND-AD:** \$4.10. **DISPLAY:** 1" x 2 1/4", \$330.00. 2" x 2 1/4", \$660.00. 3" x 2 1/4", \$990.00. **GENERAL INFORMATION:** Frequency rates and prepayment discounts available. Payment must accompany order except credit card — Am. Ex., Diners, MC, VISA (include exp. date) — or accredited ad agency insertions. Copy subject to publisher's approval; must be typewritten or printed. First word set in caps. Advertisers using P.O. Boxes MUST supply permanent address and telephone number. Orders not acknowledged. They will appear in next available issue after receipt. Closing date: 1st of the 2nd month preceding cover date (e.g., Mar. issue closes Jan. 1). Send order & remittance to: Classified Advertising, Popular Electronics Magazine, 1 Park Avenue, New York, NY 10016. Direct inquiries to Linda Lemberg, (212) 725-7686.

FOR SALE

FREE! Bargain Catalog — I.C.'s, LED's, readouts, fiber optics, calculators parts & kits, semiconductors, parts. Poly Paks, Box 942PE, Lynnfield, Mass. 01940.

GOVERNMENT and industrial surplus receivers, transmitters, sniperscopes, electronic parts, Picture Catalog 25 cents. Meshna, Nahant, Mass. 01908.

LOWEST Prices Electronic Parts. Confidential Catalog Free. KNAPP, 4750 96th St N., St. Petersburg, FL 33708.

ELECTRONIC PARTS, semiconductors, kits. FREE FLYER. Large catalog \$1.00 deposit. BIGELOW ELECTRONICS, Bluffton, Ohio 45817.

RADIO — T.V. Tubes — 49 cents each. Send for free catalog. Cornell, 4213 University, San Diego, Calif. 92105.

AMATEUR SCIENTISTS, Electronics Experimenters, Science Fair Students . . . Construction plans — Complete, including drawings, schematics, parts list with prices and sources . . . Robot Man — Psychedelic shows — Lasers — Emotion/Lie Detector — Touch Tone Dial — Quadraphonic Adapter — Transistorized Ignition — Burglar Alarm — Sound Meter . . . over 60 items. Send \$1.00 (no stamps) for complete catalog. Technical Writers Group, Box 5994, University Station, Raleigh, N.C. 27650.

SOUND SYNTHESIZER KITS — Surf \$16.95, Wind \$16.95, Wind Chimes \$22.95, Musical Accessories, many more. Catalog free. PAIA Electronics, Box J14359, Oklahoma City, OK 73114.

TELETYPE EQUIPMENT: Copy Military, Press, Weather, Amateur, Commercial Transmissions. Catalog \$1.00. **WEATHER MAP RECORDERS:** Copy Satellite Photographs, National-Local Weather Maps. Learn How! \$1.00. Atlantic Sales, 3730 Nautilus Ave., Brooklyn, NY 11224. Phone: (212) 372-0349.

BUILD AND SAVE TELEPHONES, TELEVISION, DETECTIVE, BROADCAST Electronics. We sell construction plans with an Engineering Service. Speakerphones, Answering Machines, Carphones, Phonevision, Dialers, Color TV Converters, VTR, Games, \$25 TV Camera, Electron Microscope, Special Effects Generator, Time Base Corrector, Chroma Key. Engineering Courses in Telephone, Integrated Circuits, Detective Electronics. PLUS MUCH MORE. NEW Super Hobby Catalog PLUS year's subscription to Electronic News Letter, \$1.00. Don Britton Enterprises, 6200 Wilshire Blvd., Los Angeles, Calif. 90048.

NAME BRAND Test Equipment. Guaranteed discounts up to 50%. Free catalog. Salen Electronics, Box 82, Skokie, IL 60077.



HIGH PERFORMANCE SPEAKER CABLE

\$15.95 buys a pair of 20-foot rolls of 12-gauge, twin-conductor, color-coded speaker cables. You could be losing up to half your system's performance in puny speaker wire! Ultra-low-resistance cable allows maximum damping factor in your system to get the full transient response and dynamic range your speakers are capable of. Supplies limited. Add \$2.50 per set for postage and handling.



UNSCRAMBLERS, seven models available to decode police, ambulance, and fire coded transmissions. Other scanner devices. Tone encoders/decoders. Telephone accessories, etc. Free Catalog. KRYSTAL KITS, Box 445, Bentonville, AR 72712. (501) 273-5340.

POLICE/FIRE SCANNERS, crystals, antennas, CBs, Radar Detectors. HPR, Box 19224, Denver, CO 80219.

UNSCRAMBLERS FOR any scanner. Several models available. Free literature. Capri Electronics, 8753T Windom, St. Louis, MO 63114.

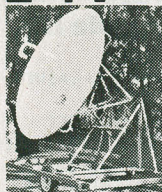
CB RADIOS, VHF-UHF Scanners, Crystal, Antennas, Radar Detectors. Wholesale. Southland, Box 3591, Baytown, TX 77520.

PRINTED CIRCUIT supplies, chemicals, tools, artwork, plating solutions. Major credit cards. Catalog \$2.00, refundable. CIRCOLEX, Box 198, Marcy, NY 13403.

RECONDITIONED TEST EQUIPMENT \$1.00 for catalog. WALTER'S TEST EQUIPMENT, 2697 Nickel, San Pablo, CA 94806. (415) 758-1050.

SATELLITE TV FOR THE HOME

Our receiver lets you get over 75 channels of television directly from earth-orbiting cable TV satellites! HBO, Showtime, super stations, sports and movies from around the world.



Sick of Network TV?

Buy Complete or

Build our kit and save!

Our 24-channel receiver provides "studio quality" TV reception. Easy to install! Ultra low power consumption! Brilliant color! Works anywhere! FCC licensing no longer required. Order today! Complete details covered in our Home Earth Station manual. Send \$7.95 today (refundable against any purchase), or call:

24-hour C.O.D. Hotline

(305) 869-4283

SPACECOAST RESEARCH

Dept. H, P.O. Box 442, Altamonte Springs, FL 32701

Buy Gov't Surplus
SAVE TO 85%

Send 60¢ For Big Bargain Catalog

1000's Of Bargains! Surplus, Excess Inventory.

Brand Name New Equipment

**COMPRESSORS • WINCHES • GEAR MOTORS
TELEPHONES • WELDERS • POWER PLANTS
SURVEYING INSTRUMENTS • ELECTRONICS
FIRE/BURGLAR ALARMS • PAINT GUNS
TARPS • BINOCULARS • TOOL BOXES
HYDRAULICS • AIR TOOLS • PUMPS**



SURPLUS CENTER Box 82209-PE Lincoln, Nebraska Zip Code 68501

NEW ELECTRONIC PARTS. Continuously stocked. Stamp brings catalog. Daytapro Electronics, 3029 N. Wilshire Ln., Arlington Hts., IL 60004.

RF POWER TRANSISTORS plus TV, audio, radio, VTR transistors, and more. IC's, diodes. B & D Enterprises, P.O. Box 32, Mt. Jewett, PA 16740. (800) 458-6053

FREE CA3140 OpAmp with every order. All top quality merchandise. Send for bargain catalog. KEY ELECTRONICS, Box 3506P, Schenectady, NY 12303.

ELECTRONIC CATALOG. Over 4,500 items. Parts, & components. Everything needed by the hobbyist or technician. \$2.00 (U.S. funds) postage & handling, refundable with first \$15.00 order. T & M Electronics, 472 East Main St., Patchogue, NY 11772. (516) 289-2520.

SAVE 50%. Build your own speaker system. Write: McGee Radio Electronics, 1901 McGee Street, Kansas City, Missouri 64108.

HOW TO BUILD CROSSOVERS. Send S.A.S.E. for catalog of crossover information publications. Mesalab, Dept. PE, 3942 Mesa Avenue, Sarasota, FL 33583.

OSI CHALLENGER 1P — Superboard II. 90 page step-by-step programming manual, \$5.95 + \$1.00 P&H. TIS, Box 921-PE, Los Alamos, NM 87544.

PRINTED CIRCUIT BOARDS, your artwork. Quick delivery. Reasonable. Atlas Circuits, Box 974, Waynesville, NC 28786. (704) 456-3739.

SATELLITE TV RECEPTION 36-page "How-To" Book. Complete reprint of Bob Cooper's 7-article series from Radio-Electronics Magazine. \$6.00 postpaid U.S. and Canada. All others add \$3.00 postage. N.Y.S. residents add 48c sales tax. SATELLITE TV RECEPTION, Box A, Radio Electronics, 45 East 17th Street, New York, NY 10003.

HAMS, CBERS, SWLS, ELECTRONICS BUFFS! Parts, kits and plans now available for Popular Electronics projects. **MORSE-A-WORD:** Circuit boards \$24.00; Essential parts kit \$99.95; Complete four character kit \$149.95; Eight character kit \$169.95; Wired \$249.95. **RTTY READER:** Boards \$24.00; Complete kit \$189.95; Wired \$269.95. **S&H \$5.00 kits;** \$1.50 boards. Use VISA/Mastercard. (414) 241-8144. Write for catalog. MICROCRAFT, POB 513PE, Thiensville, WI 53092.

RECORDS — TAPES! Discounts to 73% All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept. 5-0980, New Rochelle, NY 10801.

GIANT SCREEN TV projection kits buy direct, \$9.95. Bell Enterprises, 4616 Belair Rd., Baltimore, MD 21206. Dealer inquiries welcome.

BIOPHYSICAL MONITORING, Telemetry Transmitters: EKG — \$27.50, Pulse — \$39.50. OMNI-TEK, Dept. E, Box 1318, Longmont, CO 80501.

CABLE TV DESCRAMBLERS AND CONVERTERS. Build or buy. Plans and parts. For information send \$2.00. C&D Company, P.O. Box 26, Hudsonville, MI 49426.

PRINTED CIRCUIT BOARDS. Our years of experience deliver you top quality boards fast. And we offer what no one else dares. **GUARANTEED DELIVERY DATES.** Call or write us today. DIGITRONICS, PO Box 2494, Toledo, OH 43606. (419) 473-0985.

YOU CAN EARN \$1,000/\$3,000 weekly rebuilding CRT's. 90 day equipment sale — save \$1,500. LAKESIDE, 4071-P Elston, Chicago, IL 60618. (312) 583-6565.

RF TRANSISTORS — MRF454 — \$19.75, MRF455A — \$14.50, SRF2027 — \$18.00, SRF2857 — \$18.00. Exclusive parts and service facility for Palomar, Atlas, Pride equipment. Parts catalog available. WESTCOM, 1320 Grand, San Marcos, CA 92069. (714) 744-0728.

ELECTRONIC COMPONENTS and test equipment. Illustrated catalog 25¢. EF Electronics, P.O. Box 249, Aurora, IL 60507.

COPPER WIRE, Enamel, Tinned, Bare, Insulators. Write: Jug Wire Company, 2234 36th St., Woolsey, NY 11105.

LOGIC LAB TTL CMOS LINEAR — breadboards, function generator, six supplies, indicators, switches \$99.95. Cascade Labs, 5637 Bayview Ave., Richmond, CA 94804.

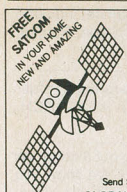
SATELLITE TELEVISION INFORMATION — Build or buy your own Earth Station. \$3.00 U.S. Satellite Television, RD 3, Oxford, NY 13830.

OSCILLOSCOPE, DC to 22 MHz. Dual Trace, Navy equivalent to HP170, \$199. Hammond, 1013 Lafayette Avenue, Colonial Heights, VA 23834.

AUDIO, VIDEO, ELECTRONIC PRODUCTS: Best pricing, prompt delivery! Sony, DBX, Teac, Tascam, Onkyo, Sound Workshop, Maxell, Mobile Fidelity Records, others. **SOUND IDEAS,** Dept. PE, P.O. Box 340, Cary, NC 27511. 1-800-334-2483. (NC-919) 467-8462).

POLICE SCANNERS — WHOLESALE PRICES. Over 25 models. Bearcat 300 — \$359.95. Regency M 400 — \$289.95. Bearcat 220 & 250 — \$279.95. Same day shipping. VISA/MC. (415) 573-1624. Free catalog. Write: Scanners Unlimited, 1199A Laurel Street, San Carlos, CA 94070.

RESISTORS 1/4W, 1/2W 5% C.F. .03c each, NO MINIMUMS. Send for stocklist and information. JR INDUSTRIES, 5834-A Swancreek, Toledo, OH 43614.



SATELLITE TV FANTASTIC 80 TV CHANNELS

A must for all homeowners and Do-it-yourselfers. Build a Video System the whole family can enjoy! No commercials, **FREE** movies, sports and Vegas Shows - worldwide, crystal clear reception connects to any TV set. 100 pages (8 x 11) loaded with photos, plans, kits - TELLS EVERYTHING!

Send \$6.95 TODAY! Add \$2.00 for 1st class (air mail). Satisfaction Guaranteed
GLOBAL TV ELECTRONICS, P.O. Box 219-A, Maitland, FL 32751

SCRAMBLED TELEVISION — Encoding/Decoding. New publication. Complete theory, circuits. \$9.95. Workshop, Box 393PE, Bethpage, NY 11714.

SATELLITE TELEVISION — New package includes: ANTENNA AIMING DATA computed for your latitude, longitude, (plotted by Compusat), Revised listing of U.S. and international geostationary satellites, transponder video frequencies, audio subcarriers, formats, antenna/feedline data and more. All for \$10.00. COMPUSAT, 643 South Route 83, Elmhurst, IL 60126.

KEYBOARDS — High quality 61-note single or dual contact for the organ or synthesizer you are building. Send for information. Devtronix, Dept. 71, 6101 Warehouse Way, Sacramento, CA 95826.

DOLBY FM AS IT SHOULD BE HEARD. Assembled Decoder \$99.50. Also encode/decode kit for recordists. SPE INTERGEX, Box 747, Havertown, PA 19083.

FIBER OPTIC SPECIALS — 100 foot spool of fiber \$3.00 — Experimenter's kit \$6.00 — High Power LED with matched Detector \$10.00 — Data Link construction plans (detailed) \$5.00. Catalog with samples \$1.00. FIBERTRONICS, Box 322-A, Primos, PA 19018.

GEL CELL rechargeable batteries 6v @ 7.5 amp-HR. 6 x 3 3/4 x 2" wt. 3 lbs. \$25.00. Free catalog. In-X-Sales, Box 222, Medford, MA 02155.

HIGH PERFORMANCE Speaker Kits, Drivers. Transmission lines, Push-pull reflex. Audax, Dalesford bextrenes, Decca ribbons, Jordan Modules. Brochure \$1.00. Lazer Audio, P.O. Box 943, Union City, CA 94587.

RARE OUT-OF-PRINT ALBUMS. 25,000 in stock (FS). List \$2.00 refundable. Record Warehouse, Box 4617, Dept. PE, Rochester, NY 14613.

GOV'T SURPLUS EQUIPMENT, PARTS, TUBES. Catalog 50c. G&G Radio, 45 Warren St., New York, NY 10007. (212) 267-4605.

Telephone Listening Device

Record telephone conversations in your office or home. Connects between any cassette or tape recorder and your telephone or telephone LINE. Starts automatically when phone is answered. Records both sides of phone conversation. Stops recorder when phone is hung up. This device is not an answering service.



Each \$18.95
Qty. Disc. Avail.

Super Powerful Wireless Mic

10 times more powerful than other mics. Transmits up to 1/4 mile to any FM radio. Easy to assemble kit. 15V battery (not incl.)

Call (305) 725-1000 or send \$18.95 + \$1.00 shipping per item to USI Corp., P.O. Box PE-2052, Melbourne, FL 32901. COD's accept. For catalog of transmitters, voice scramblers and other specialty items, enclose \$2.00 to USI Corp.



Size 2"x3"x1"

POLICE SCANNERS — Wholesale prices. Bearcat 210 — \$179.95. VISA/MC. Free catalog. Scanners, 6580 Frankstown Ave., Pittsburgh, PA 15206. (412) 441-9659.

HV CAPACITORS, ceramic silver plated, 15KV 500pf., 10/\$8.00 plus \$1.00 U.P.S. Star Wind, PO Box 184, Goleta, CA 93017.

ELECTRONIC TOYS AND GAMES. Booklet with photos and schematics for 10 toys, \$5.00. Micron, 210 E. Belcrest Rd., Bel Air, MD 21014.

SHORT WAVE LISTENERS! Free catalog of short wave receivers, digital frequency displays, Collins filters, active All-Band receiving antennas, loop antennas and special DX modifications! Radio West, 3417 Purer Road, Escondido, CA 92025. (714) 741-2891.

WWVB RECEIVER. The ELEMEX Model LXX receives the 60KHZ WWVB signal. Brochure. Elemex, 6500-P Joy Rd., East Syracuse, NY 13057.

AMATEUR RADIO

MADISON DEEP HAM DISCOUNTS. Kenwood, Yaesu, Icom, Drake, Accessories — Stock. FREE flyer, Madison Electronics, 1508-P McKinney, Houston, TX 77002. (713) 658-0268.

HEAVY DUTY REPLACEMENT TRANSFORMERS for HAM/ CB. Write for list. Dahl Co., 4007-P Fort Blvd., ELP/TX 79930. (915) 566-5365.

RADIO AMATEUR CALLBOOKS: Directories of Radio Amateurs around the world. Write for FREE catalog. Radio Amateur Callbook, Dept. PE, 925 Sherwood Dr., Lake Bluff, IL 60044.

C.B. EQUIPMENT

FM TWO-WAY RADIO. Confused? Don't gamble with your dollars! Send \$3.00 for an informative "BEGINNERS GUIDE" to: Two-Way, Box 1302, South Bend, IN 46624. Money-Back Guarantee.

GET MORE CB CHANNELS! Frequency Expanders, boosters, how-to books, plans, kits. Catalog \$1. CB CITY, Box 31500PE, Phoenix, AZ 85046.

CHARLES GIZMOTCHY™ ANTENNAS AND COAXIAL SWITCHES. Dealer inquiries welcome. Charles Radio Co., 6836-P Pearl City Road, Freeport, IL 61032.

COMPUTER EQUIPMENT

Now decode exotic radio signals

Field Day is a real computer that reads all kinds of coded radio transmissions. Not only Morse code, but radioteletype, press-wire reports and ASCII computer talk. Figures code speeds. Built-in 24-hour clock. Wired, tested, full-year warranty, 15-day trial. Easy hook-up to any receiver. \$467.95 UPS ship. Charge, check or C.O.D. No risk!

Kantronics, Inc. 1202 E. 23rd St.
Amateur radio manufacturers. Lawrence, KS 66044
(913) 842-7745

FLOPPY DISKS and COMPUTER PERIPHERALS at DISCOUNT PRICES. AB COMPUTERS, 115-E East Stump Road, Montgomeryville, PA 18936. (215) 699-5826.

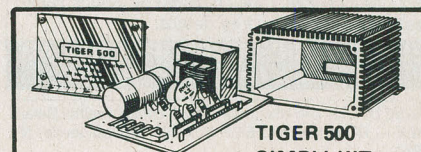
COMPUTER COVERS — TRS-80, Apple, Pet, Printers, Disks, etc. For sample/prices write: COMPUCOVER, Box 324-PE, Mary Esther, FL 32569. (904) 243-5793.

QUEST ELF OWNERS — Modify your units for full memory address display in monitor mode. Send \$3.00 to: Pearce, Box 237, St. Norbert, Manitoba, Canada R3V 1L6.

APPLEII GPIB Uses powerful 6522VIA. Two parallel ports, shift register, two timer-counters. SASE data. \$59.50. microAustin, PO Box 14408, Austin, TX 78761.

PLANS AND KITS

FREE KIT Catalog contains Test and Experimenter's Equipment. Dage Scientific Instruments, Box 1054P, Livermore, CA 94550.



TIGER 500
SIMPLI-KIT

FOR THE DO-IT-YOURSELFER

NOW! a high quality CD ELECTRONIC IGNITION SYSTEM in kit form.

Contains all components and solder to build complete Solid-State Electronic CD Ignition System for your car. Assembly requires less than 3 hours.

- Increases MPG 15%
- Increases horsepower 15%
- Eliminates 4 or 5 tune-ups
- Instant starting, any weather
- Plugs and Points last 50,000 miles
- Dual system switch

Fits only 12 volt neg. ground...
Only \$26.95 postpaid

Tri-Star Corporation

P.O. Box 1727 Grand Junction, Colorado 81501

PROJECTION TV . . . Convert your TV to project 7 Foot picture. Results equal to \$2,500 projector. Total cost less than \$20.00. **PLANS & LENS** \$16.00. Illustrated info. FREE: Macromcom, Washington Crossing, PA 18977.

SPEAKERPLANS — Build ANY size speakers without special tools, experience. FOOLPROOF, illustrated instructions, parts sources. 80% SAVINGS! Rush \$4. **SPEAKERPLANS**, 334 Pursel, Phillipsburg, NJ 08865.

PRINTED CIRCUIT BOARDS, send your sketches or artwork, kit projects. Quick Service. Free Estimates. **ELECTRONIC DESIGN CONCEPTS**, 2780 Skyline Circle, Memphis, TN 38127.

NEW-UNSCRAMBLER PLANS. State of art integrated circuit design. Fits all scanners. Complete plans, \$3.95. Innovative Marketing, Box 7577, Huntington, WV 25777.

TOP QUALITY SPEAKERS AND KITS. Send \$1.00. Speaker Warehouse, 809 North Route 441, Hollywood, FL 33021.

LASERS HANDBOOK with burning, cutting, Ruby Reds, CO's complete plans, books, and parts. Send \$4.00 to: Farnco, Dept. PE, Box 1902, Rochester, NH 03867.

SATELLITE TV ANTENNA build for \$300. Detailed plans \$30. Numan Enterprises, Rt. 1, Box 357, Jonesboro, TN 37659.

TELEVISION ALIGNMENT — In minutes! Revolutionary, inexpensive. Free Details. John Kozulko, Box 2702P, Clearwater, FL 33517.

BUILD CUSTOM STEREO SPEAKERS. For instructions send \$3.00 to: Constructa Speaker, Box 1124, Melrose Park, IL 60160.

SCOPE used as transistor tester, convert for under \$10.00. Plans \$1.50. AEE, Box 6531, Portsmouth, VA 23703.

PRINTED CIRCUIT Boards from sketch or artwork. Kit projects. Free details. DANOCINTHS Inc., Dept. PE, Box 261, Westland, MI 48185.

NEGATIVE Ion Generator Plans includes Ion Detector. Send \$5.00. HEK Publishing, 6205 Joyce Drive S.E., Washington, DC 20031.

KIT BUILDERS DELIGHT — level controls, ferrite chokes, electrolytic caps, drivers, cabinets, crossovers, plans, car speakers, speaker closeouts below cost! \$2.00 for complete catalog. C.C.L. Enterprises, Inc., 30682 San Antonio St., Hayward, CA 94544. (415) 487-1144.

MULTISONIC STEREO IMAGER, 3-D time delayed sound comparable to nationally advertised unit. Builds in 1/2 hour. Kit \$69.00, P.C. boards \$30.00, Complete \$99.00. VISA/Mastercard (914) 255-5521. L.S. Audio, P.O. Box 935, New Paltz, NY 12561.

COMPLETE PLANS & PARTS LIST for the following circuits: D-37 muting for stereo via telephone — ring or off hook — \$3.00, D-17 waterbed temperature control — \$4.00, D-43 electronic telephone ringer — \$2.00, D-76 12v battery charger control — \$4.00, D-9 TV/Audio interface to stereo system — \$2.00, D-81 20 energy saving projects for households — \$6.00, D-18 Scanner/Tape Recorder interface (fully automatic) — \$3.00. E-TIPS, Box 467, Belvidere, IL 61008.

COMPUTER DESIGNED Stereo Speaker Kits. All designs computer tested. Build your own cabinets; save a bundle. For information send 50c to: Vorg Products, 2260 Maplewood, Cleveland Heights, OH 44118.

SUBSCRIPTION TV EDUCATIONAL KIT

If there's a TV channel in your area you can't tune to and get a proper picture or sound, chances are you're seeing a subscription TV signal. Now you can find the signal. Our 24-page illustrated manual contains a description of how such a system works and includes construction details for building a circuit to restore the audio and video signals to their original state. Our circuit is proven in many areas of the U.S., but does require use of a scope and is not intended for beginners.

Manual only \$15.00
Drilled and etched PC project board 23.00
Board and manual 35.00
Complete kit 69.00

MICRO MART

552 Summit Ave., Westfield, NJ 07090 (201) 654-6008
VISA & MC accepted

ALARMS

Burglar-Fire Protection



Protect Your Life, Home, Business, Auto, etc.

- Our catalog shows how. Install your own alarm systems and devices and save \$\$\$\$.
- We offer FREE write-in engineering service.

FREE CATALOG Lowest Prices on Reliable, High-Quality Alarm Systems and Devices

Burdex Security Co. Box 82802-PE Lincoln, Ne. 68501

POLICE DIALER \$29.95. Free burglar alarm equipment catalog. Sasco, 5619P St. John, Kansas City, MO 64123. (816) 483-4612.

BURGLAR, FIRE, CAR! Finest equipment! Save! Free Catalog. Refundable! AAS, 186A Oxmoor Road, B'ham, AL 35209.

EVER ACCIDENTALLY left your car lights on and stranded yourself with a dead battery? Easily installed light alarm will remind you if you ever forget again. \$12.95. Olmtech, Inc., Box 12583, Gainesville, FL 32604.

TUBES

RADIO & T.V. Tubes — 49 cents each. Send for free Catalog. Cornell, 4213 University, San Diego, Calif. 92105.

TUBES: "Oldies". Latest. Supplies, components, schematics. Catalog Free (stamp appreciated). Steinmetz, 7519-PE Maplewood, Hammond, Ind. 46324.

TUBES-RECEIVING, Industrial and Semiconductors Factory Boxed. Free price sheet including TV, Radio and audio parts list. Transletronic, Inc., 1365 39th St., Brooklyn, New York 11218. Telephone: (212) 633-2800. Toll free: 800-221-5802.

ANTIQUE AND OBSOLETE TUBES \$1.00 to \$5.00. \$1.00 for list. Preller T.V., Augusta, AR 72006. (501) 347-2281.

HIGH FIDELITY

DIAMOND NEEDLES and Stereo Cartridges at Discount prices for Shure, Pickering, Stanton, Empire, Grado, Audio Technica, Osawa, Satin and ADC. Send for free catalog. **LYLE CARTRIDGES**, Dept. P, Box 69, Kensington Station, Brooklyn, New York 11218. Toll Free 800-221-0906 9AM - 8PM except Sunday.

GOVERNMENT SURPLUS

MANUALS for Govt Surplus radios, test sets, scopes. List \$1.00 (cash). Books, 7218 Roanne Drive, Washington, D.C. 20021.

SURPLUS JEEPS — \$19.30!! — **CARS** — \$13.50!! — 650,000 ITEMS!! — **GOVERNMENT SURPLUS!!** — Most **COMPREHENSIVE DIRECTORY** AVAILABLE tells how, where to buy!! — **YOUR AREA** — \$2. — **MONEYBACK GUARANTEE!!** — "Government Information Services", Department GE-41, Box 99249, San Francisco, California 94109.

"**GOVERNMENT SURPLUS DIRECTORY.**" Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available — \$2.00. Surplus Disposal, Box 19107-HI, Washington, DC 20036.

ATTENTION campers, shooters, divers, bikers, cavers. Great new catalog. Send \$2.00 (refundable). Axis Surplus Sales, Box 9933F, Atlanta, GA 30319.

PERSONALS

MAKE FRIENDS WORLDWIDE through international correspondence, illustrated brochure free. Hermes-Verlag, Box 110660/Z, D-1000 Berlin 11, W. Germany.

PENFRIENDS — **ENGLAND** — **USA**, through correspondence. Send age, interests. Free reply. Harmony, Box IPE, Brooklyn, New York, 11223.

TRAVEL/VACATIONS

SAVE ON LUXURY CRUISE! (passenger ship or freighter). How? Ask TravLtips, 163-09 Depot L909, Flushing, NY 11358.

INSTRUCTION

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.D.'s. Free revealing details. Counseling, Box 317-PE09, Tustin, California 92680.

LEARN WHILE ASLEEP! HYPNOTIZE! Astonishing details, strange catalog free! Autosuggestion, Box 24-ZD, Olympia, Washington 98507.

RADIO BROADCASTING: Become DJ, engineer. Start your own station — investment/experience unnecessary! Receive free equipment, records. Free details. Broadcasting, Box 130-A9, Paradise, CA 95969.

LEARN ELECTRONIC ORGAN SERVICING at home. Completely revised course covers latest models including digital, LSI's, synthesizers, etc. **NILES BRYANT SCHOOL**, PO Box 20153, Sacramento, CA 95820.

PASS FCC EXAMS

The Original FCC Tests-Answers exam manual that prepares you at home for FCC First and Second class Radiotelephone licenses. Newly revised multiple-choice exams cover all areas tested on the actual FCC exam. Plus "Self-Study Ability Test." Proven! \$9.95 postpaid. Moneyback Guarantee.

COMMAND PRODUCTIONS
Radio Engineering Division

P.O. Box 26348 P
San Francisco, CA 94126

MEDICAL ELECTRONICS TECHNOLOGY, home study. Troubleshoot medical instruments. University Reme 5, Box 9622, Fresno, CA 93793.

LEARN MORSE CODE. One hour of practice material at 3, 5, and 6 WPM on cassette tape. Prepares you for Novice exam. Includes code groups, punctuation and numbers. Instructions included. \$6.00 postpaid. A and F Enterprises, P.O. Box 47152, Atlanta, GA 30362.

COLLEGE DEGREES BY MAIL! No classes. Fast. Economical. Accredited. **FREE** Revealing details. Success, Box 13151-R9, Columbus, Ohio 43213.

FOR INVENTORS

PATENT AND DEVELOP Your invention. Registered Patent Agent and Licensed Professional Engineer, Send for **FREE PATENT INFORMATION** every inventor should have. Richard L. Miller, P.E., 3612 Woolworth Building, New York, NY 10007. (212) 267-5252.

INVENTIONS WANTED

FREE CONSULTATION • **NO IDEA TOO SMALL**

Disclosure registration. Potential cash or royalties from manufacturers seeking new ideas. For free information on how to register your ideas. Call or write.

AMERICAN INVENTORS CORP.

59 Interstate Dr. Dept PE
West Springfield, MA 01089 (413) 737-5376
A Fee Based Service Company

NEW! "Patenting Your Invention Yourself!", \$29.95. Guaranteed! Registered Practitioner, 7400 ZD, Washington, DC 20044. Invention Record Free!

INVENTORS Patent your invention. Free initial consultation. We are registered by the U.S. Government. **VICTOR J. EVANS & CO.**, 4637 Eastern Ave. N.E., Washington, DC 20018. Since 1898.

PATENT SEARCHES, LOW FEE, Since 1940. Whitehurst, Box 8022, JFK Post Office, Boston, MA 02114.

CUSTOM PROTOTYPING from your ideas. Confidential. **SUPER WIDGETS & Gizmos**. (817) 387-2189.

IDEAS, INVENTIONS, new products wanted! Write for Kit-PE, IMI, 701 Smithfield, Pittsburgh, PA 15222.

BUSINESS OPPORTUNITIES

I MADE \$40,000.00 Year by Mailorder! Helped others make money! Details 25¢. Torrey, Box 318-NN, Ypsilanti, Michigan 48197.

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

MECHANICALLY INCLINED individuals desiring ownership of Small Electronics Manufacturing Business — without investment. Write: **BUSINESSES**, 92-K2 Brighton 11th, Brooklyn, New York 11235.

MECHANICALLY INCLINED INDIVIDUALS

Assemble electronic devices in your home. Knowledge, or experience not necessary. Get started in spare time. Above average profits. \$300 - \$600/Wk possible. Sales handled by others. No investment — Write for free details.

ELECTRONIC DEVELOPMENT LAB
Box 1560PE, Pinellas Park, FL 33565

ERASE DEBTS with little-known law — create wealth!! Details **FREE** — Blueprints, No. EE9, Box 100, LaGrangeville, NY 12540.

DIGITAL WATCH REPAIR — Learn to repair digital watches — provide service to jewelry and department stores — part time or full time. We supply training — equipment — replacement parts. Zantech, Inc., 13 Greentree Rd., Trenton, NJ 08619. (609) 586-5088.

\$625/WEEKLY! Home mailing program. Free postage — supplies!! — \$20 bonus! Write immediately. Treasure-7Y, Morrison, CO 80465.

BORROW \$25,000 "OVERNIGHT." Any purpose. Keep indefinitely! Free Report! Success Research, Box 29263-GI, Indianapolis, IN 46229.

SPARE TIME FORTUNE in Vinyl Repair. Huge demand creates exceptional profits. We supply everything. Details free. VIP, 2012 Montrose, Chicago, IL 60618.

ARE YOU A YOUNG AND Enthusiastic Computer Engineer in the U.S.A. hoping to start your own business some day. Send Curriculum vitae to: H.N. Bronkhorst, Janvethstraat 66, 6813 HM Arnhem, Netherlands.

START BIG-PAY BUSINESS AT HOME IN SPARE TIME. No experience needed to operate little tabletop machine for bronzing baby shoes. Be your own boss, freedom from time cards. Full particulars Free! Send postcard to: Curt, Room MC-376-JK, 1512 Jarvis, Chicago, IL 60626.

PROJECTION TV . . . Make \$200.00+ per evening assembling Projectors . . . Easy . . . Results equal to \$2,500 projectors . . . Your total cost less than \$15.00 . . . **PLANS, LENS & Dealer's information** \$14.00 . . . Illustrated information **FREE** . . . Macrocomax, Washington Crossing, PA 18977.

ENERGY CONSERVATION! America's dynamite industry! Free information. Hale Energy, Dept. G, 4110 Soule, Eureka, CA 95501.

GOLD . . . from electronics, jewelry, scrap. Guaranteed industry procedures, secrets. \$5.95 (Texas +30¢). **AUROTECH**, MS103, 2806 Geraghty, Austin, TX 78757.

\$700 PER MONTH EARNINGS possible filling out income tax forms at home or tax office during tax season. We show you how. Simple, quickly learned. Details mailed free. No salesmen. Hurry. Big demand. Federated Tax, 2012 Montrose, Chicago, IL 60618.

EMPLOYMENT OPPORTUNITIES

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details **FREE**. Aviation Employment Information Service, Box 240E, Northport, New York 11768.

MAKE YOUR HOBBY YOUR CAREER! High demand electronic job market! Get unique guide booklet — prepare for exciting, rewarding jobs. Send \$3.95 to: Files, Box 459E, Massapequa, NY 11758.

REPAIRS & SERVICES

TV TUNERS REBUILT, VHF or UHF only \$11.90. Send for free mailing kit. JW Electronics, Box 51A, Bloomington, IN 47402.

ALL T.V. TUNERS repaired \$11.95. Fast, quality work. **MIKE'S T.V. TUNER SERVICE**, Box 187, Bean Station, TN 37708. (615) 581-6393.

PRINTED CIRCUIT BOARD ASSEMBLY. Precision soldering, reasonable rates. Free info. Solderkraft, 647 Penryn Road, Manheim, PA 17545.

DO-IT-YOURSELF

SAVE 90%. Build your own minicomputer. Free details. **DIGITRONICS CORPORATION**, 2723C W. Butler Cr., Phoenix, AZ 85021.

REAL ESTATE

BIG . . . FREE . . . FALL CATALOG! Over 2,700 top values coast to coast!! **UNITED FARM AGENCY**, 612-EP West 47th, Kansas City, MO 64112.

RUBBER STAMPS

RUBBER STAMPS, BUSINESS CARDS. Many new products. Catalog. Jackson's, E-100, Brownsville Rd., Mt. Vernon, Ill. 62864.

MOTION PICTURE/VIDEO

GREAT NEWS! 3 Stooges comedies 400' S-8 B&W Snd avail. again! Immediate delivery, Micro Phonies (#7200); Women Haters (#7310); A Bird in the Hat (#7110), Abbot & Costello "In The Navy" — only \$48.75 ea del (reg \$59.95). Sound Good? They're great! Lantz "Woody The Woodpecker" col. cartoons 200' Eastman col snd only \$31.85 ea PPD. Choice: Stage Hoax; Dippy Diplomat; Arts & Flowers. Official NFL Funnies, 400' S-8 col snd bloopers \$54.95 ea; Football Follies 200' S-8 col sil, \$21.95 ea. Maj. League base. off. S-8 snd film & video cass. Roberto Clemente "A Touch of Royalty", hilites Pittsburgh star's career, \$51.95 ea (list \$59.95). Grt moments in baseball, early league all-stars to '60; S-8 B&W snd 400' \$48.95 ea. Sportlite also features your choice any World Series from 1959-79, ea a separate tape, \$74.95 ea + \$2.50 ea ship. Indicate year, Beta II, VHS. Charge Visa or Master Card. Penny Pinchers: '71 World Series (Pirates/ Balto) ea 200' St 8 B&W \$4.95; All-Star Baseball Game; RFK, 1928-65; 200' St 8 \$4.95 ea. Scenes from "Cowboy" (J. Lemmon) St 8 col 200' sil \$6.95 ea. A Murray dance lessons 50' St 8 B&W; Waltz, Swing; Fox Trot, \$2.99 ea or 3/\$6.75. Ring Classics lists 50c. Paramount Pix lists 50c; Univ S-8 Sil & Sd cat \$1.25; Univ S-8 Sd only \$1.1; Col. VTR cat 75c. *Add \$2. **SPORTLITE FILMS**, Elect-9, Box 24-500, Speedway, IN 46224.

HYPNOTISM

FREE Hypnotism. Self-Hypnosis. Sleep Learning Catalog! Drawer H400, Ruidoso, New Mexico 88345.

HOBBIES

3 OLD LIBERTY HEAD NICKELS Only \$1.00. Issued before 1913. Limit 1 set. (Adults only). Plus price lists. Littleton Coins, HL-17, Littleton, NH 03561.

WANTED

GOLD, Silver, Platinum, Mercury, Tantalum wanted. Highest prices paid by refinery. Ores assayed. Free circular. Mercury Terminal, Norwood, MA 02062.

BOOKS AND MAGAZINES

ELECTRONIC MUSIC and home recording in Polyphony magazine. Advanced applications, interviews, projects, computer music. Sample \$1.50. Subscription (6 issues). \$8.00 US/\$10.00 foreign. POLYPHONY, Box P20305, Okla. City, OK 73156.

TOTAL MIND POWER (how to use the other 90% of your mind). FREE BOOKLET. Total Mind Power Institute #37, Larkspur, CA 94939.

CLEARLY ILLUSTRATED, inexpensive do-it-yourself books. From home repairs to furniture construction. Brochure: \$1.00 (refundable). Craftbooks, P.O. Box 726, Concord, NH 03301.

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalog: Hamilton, 98-84 Clapboard, Danbury, CT 06810.

MISCELLANEOUS

MPG INCREASED! Bypass Pollution Devices easily. RE-VERSIBLY!! Free details — Posco GEE9, Box 300, La-Grangeville, NY 12540.

RINGS, JEWELRY priced 130% below retail price. Catalog \$1.00 (refundable). Anka-PE, 95 Washington, West Warwick, RI 02893.

FREE INFORMATION! Fuel-economy tuning secrets explained. Technering, Box 12191DD, Norfolk, VA 23502.

Save on Calculators

Model	Your Cost
HP-41C Scient	\$264.95
Card Reader/41C	184.95
Printer/41C	324.95
HP-34C Scient	124.95
HP-38C Bus.	124.95
HP-33C Scient	99.95
HP-38E Bus.	94.95
HP-37E Bus. prog	58.95
HP-32E Adv. Scient	53.95
HP-67 Scient Prog	298.95
HP-97 Scient Print	579.95
HP-92 Bus. Print	398.95

"C" stands for continuous memory

We carry an enormous stock of HP accessories. All units complete. One year guarantee by HP

TEXAS INSTRUMENTS

TI-59	208.95	TI-5015	63.95	58/59 Libraries	34.95
TI-58C	98.95	TI-5100	38.50	TI-Programmer	54.95
PC-100C	169.95	TI-5200	Call us	Bus Analyst I	20.50
TI-55	34.95	TI-5225	Call us	Bus Analyst II	39.50
TI-50	33.50	TI-5221	Call us	TI-Translator	229.95
TI-35	24.50	TI-5230	Call us	TI-Thermostat	119.95
TI-30SP	17.50	TI-MBA	58.95	Speak and Spell	62.95
TI-5040	92.95				

Huge inventory of TI accessories on hand at all times. Guarantee by TI

Computers at unbeatable prices

APPLE II Computer

Accessories and peripherals. For immediate delivery call us. Apple II, the complete computer system. Please inquire about the new Apple III.

Texas Instruments

99/4 Console	695.00
Color monitor for 99/4	395.00
RF Modulator for 99/4	69.95
APF Imagination Machine	Call us
ATI Models 800 and 400	Call us
Mattel Intellivision #2609	249.95
Mattel Keyboard component #1149	429.95

Prices f.o.b. L.A. Minimum freight & handling charge—\$4.95. In CA, add 6% sales tax. Goods subject to availability. We'll beat any advertised price if competitor has goods on hand.

Request our 100 page catalog in writing.

Outside CA, toll free 800-421-8045

In CA, Call below #s Call Mon.-Sat. 7AM - 6PM

OLYMPIC SALES COMPANY INC.

216 South Oxford Avenue • P.O. Box 74545 • Los Angeles, CA 90004

(213) 381-3911 or (213) 381-1202 • Telex 67-3477

CIRCLE NO. 54 ON FREE INFORMATION CARD

HEWLETT PACKARD



HP-85 COMPUTER

We have the lowest prices in the nation. If you have an order somewhere else, cancel it and re-order from Olympic Sales. All accessories and peripherals.

BULLET

ELECTRONICS, Inc.

P.O. Box 401244P Garland, TX. 75040

Music For Your Ears

Bullet's Electronic Music Maker™ Kit has a single 28 Pin Microprocessor Chip with ROM that has been programmed to play the first 6 to 10 notes of the 25 popular tunes listed below. Each tune can easily be addressed individually or played sequentially at the push of a button. The 3 chime sequences are activated at any time by separate switch closures so when used as a doorbell, one door can play songs while two others will play different chimes. The unit has a 5 watt audio Amp and will run on either 12VAC or 12VDC. Optional 117VAC transformer is available. Construction is very simple, works with any 8 or 16 ohm speaker, or horn speaker (Not included.) Tunes can be remotely programmed using a single rotary switch, (not included), if desired.

Complete Kit

\$16.95

Transformer \$1.35
(For operation on 117VAC)



Tunes: Toreador • William Tell • Hallelujah Chorus • Star Spangled Banner • Yankee Doodle • America • Deutschland Lied • Wedding March • Beethoven's 5th and 9th • Hell's Bells • La Vie En Rose • Star Wars Theme • Celine Dion • Augustine • Jingle Bells • God Save The Queen • Colonel Bogey • Marseillaise • O Sole Mio • Santa Lucia • The End • Blue Danube • Brava Lullaby • Westminster Chime • Simple Chime • Descending Octave Chime.

Sound Effects Kit \$18.50

The SE-01 Sound Effects Kit is a complete kit, all you need to build a programmable sound effects machine except a battery and speaker. Our kit is designed to really run out the TI 76477 Sound Chip. Only the SE-01 provides you with additional circuitry that includes a PULSE GENERATOR, MUX OSCILLATOR and COMPARTOR to make more complex sounds a snap. We help you in building the kit with a clear, easy-to-follow construction manual and we show you how to easily program the unit. Other dealers will sell you the chip or a "kit" of parts but you are on your own to do the most difficult part...make neat sounds! Within a short time after you build the SE-01 you can easily create Gunshots, Explosions, Space Sounds, Steam Trains, and much more. We think the Bullet SE-01 is the best deal on the market but don't ask us — ask the 15,000 happy SE-01 owners!

Complete Kit With Quality Plated PC Board \$18.50

(Less battery & speaker)

Users Group Notes: Includes additional programming charts plus quarterly updates \$5.00

7 Watt Audio Amp Kit \$5.95

SMALL, SINGLE, HYBRID IC and COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP. LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT.

AY3-8910 PROGRAMMABLE SOUND GENERATOR

The AY3-8910 is a 40 pin LSI chip with three oscillators, three amplitude controls, programmable noise generator, three mixers, an envelope generator, and three D/A converters that are controlled by 8 BIT WORDS. No external pots or caps required. This chip hooked to an 8 bit microprocessor chip or Buss (8080, 280, 6800 etc.) can be software controlled to produce almost any sound. It will play three note chords, make bangs, whistles, sirens, gunshots, explosions, bleets, whines, or grunts. In addition, it has provisions to control its own memory chips with two IO ports. The chip requires +5V @ 75ma and a standard TTL clock oscillator. A truly incredible circuit.

\$14.95 W/Basic Spec Sheet (4 pages)

60 page manual with S-100 interfacing instructions and several programming examples, \$3.00 extra

PN2222 (2N2222A)

MOST POPULAR NPN GEN. PURPOSE TRANSISTOR.
TO - 90 Vce = 40V
Pd = 5W
Hfe = 100 - 300
10/\$1.00 100/\$9.00

SILICON POWER TRANSISTOR

*2N5191 NPN
Vce = 60V Pk 40W
IC = 4A
Hfe 25-100
@ 1.5A
*HSE #



THE PERFECT TRANSFORMER

117VAC primary, 12VAC secondary @ 200ma
Great for all you CMOS, or low power TTL projects. PC board mount.

99¢ ea. \$3/2.50

Size: 1.5" W x 1.25" D x 1.25" H



ORDER XFMR-03

COMPONENTS

301 OP AMP 8 LEAD CAN	3/1.00	TIP30 TAB PNP POWER	3/1.00
723 VOLT REG. 10 LEAD CAN	.39	*MC1351P FM IF. DISC IC	.50
723 14 PIN DIP	.50	11400 BAR TEMP. COEFF. RES	2.50
13741 FET INPUT 741 MINI DIP	3/1.10	7805 5V 1A REGULATOR	.99
30.000 @ 15V COMPUTER GRADE	2.10	*78M05 -1A 5V REG. TO S	.60
2N4402 PNP COMPLIMENT	8/1.00	LM331 1 PIN TRANSCEIVER	.60
2N6028 P.U.T. W/SPECS	.50	IC W/SPECS	1.10
LM380 2W AUDIO IC W/SPECS	1.09	LM3302 QUAD COMPARTOR IC	.50
LM377 DUAL LM380 W/SPECS	2.50	555 TIMER IC	.49
LM3900 QUAD NOTION AMP	.69	*MC3401 QUAD NOTION AMP	.39
LM324 QUAD OP AMP	.55		
7812 1A 12V REG	.95		
IL1 OPTO ISOLATOR MINI DIP	.60		
*MEN 631 DUAL DATE MOSFET.			
DIODE PROTECTED, SIMILAR			
TO 40673			
MU1004 VARICAP DIODE 10 PFD	.50	JUMBO GREEN LED'S	4/.89
1N5148 VARICAP DIODE	.39	JUMBO RED LED'S	5/.89
47 PFD NOM. 3:1 RATIO	.49	MEDIUM GRN OR YELLOW	.15
1N4003 1A 200V DIODE	15/1.00	BI-POLAR LED	.49
		TWO COLOR RED/GRN	.59

★ CALL OR WRITE FOR FREE CATALOG. ★

THE FINE PRINT

NO C.O.D.'s. SEND CHECK, MONEY ORDER, CREDIT CARD *
ADD 5% FOR SHIPPING TX. RES. ADD 5% TAX FOREIGN ORDERS
(EXCEPT CANADA) ADD 10% (20%) AIRMAIL U.S. FUNDS ONLY
PHONE ORDERS ON MASTER CHARGE & VISA ONLY
(214) 278-3553

HOBBYWORLD[®] ELECTRONICS INC.

SEND FOR FREE FLYER FEATURING:

PAGE AFTER PAGE OF EXCITING PRODUCTS... WE STOCK COMPUTERS, TERMINALS, MONITORS, PRINTERS, DISKDRIVES, AND MANY MORE ELECTRONICS PERIPHERALS THAT CAN ADD DIMENSION TO YOUR PERSONAL COMPUTING. WE ALSO CARRY COMPLETE LINES OF COMPUTERIZED TOYS & GAMES, APPLICATION BOARDS, COMPREHENSIVE SOFTWARE, ELECTRONICS BOOKS, ELECTRONICS PARTS, P.C. & SOLDERING ACCESSORIES, AND MUCH MUCH MORE AVAILABLE AT TERRIFIC HOBBYWORLD PRICES!!!

OUR LINE OF BRAND NAME PRODUCTS INCLUDE: ATARI, COMPCOLOR, CALIFORNIA COMPUTER SYSTEMS, ANADIX, MATTEL, COLECO, ENTEN, FIDELITY, AND MORE MORE... CIRCLE OUR READER SERVICE NUMBER OR WRITE/PHONE US FOR YOUR FREE ILLUSTRATED FLYER TODAY!

HOBBYWORLD[®] ELECTRONICS

AMERICA'S LARGEST ONE-STOP MAIL ORDER COMPUTER CENTER!

DEPT P9
CALL US TOLL FREE
IN USA: (800) 423-5387
IN CALIF: (800) 382-3651
LOCAL/OUTSIDE USA: (213) 886-9200
19511 BUSINESS CENTER DR
NORTHridge, CA. 91324

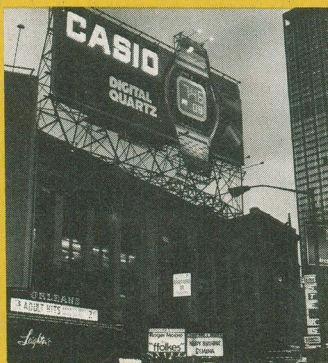
CIRCLE NO. 34 ON FREE INFORMATION CARD

ELECTRONICS WORLD®

Personal Electronics News

A WORLD-CHAMPIONSHIP BOXING MATCH was made available, for the first time in cable-TV history, on a pay-per-view basis with the cablecast of the June 20 Sugar Ray Leonard/Roberto Duran fight. The venture was a joint undertaking by Top Rank Productions and Warner Amex Cable Communications, Corp. Warner Amex's two-way QUBE system also allowed viewers to rate the fight during the live cablecast at the end of each round by pressing a button on their home consoles. QUBE's central computer tabulated the results and flashed comparisons of viewer, TV announcer, and official opinions on home TV screens.

AN AUDIO COMPUTER from Crown International, Elkhart, IN, analyzes sound. Called Badap 1, it's designed to replace a series of dedicated test instruments. Uses a color CRT to display data, with all data captured digitally and stored in memory. Even in real-time analysis, all data is processed through memory, enabling users to expand or contract a display to include only that segment of immediate interest. Up to eight data sequences can be displayed at a time through use of a system of bars and dots and four NTSC-compatible colors. The NTSC-compatible display makes it possible to videotape the display or to show it on a larger remote monitor. Since software for the system is on circuit boards, as new routines are developed, Badap 1 owners can simply add boards instead of buying new instruments.



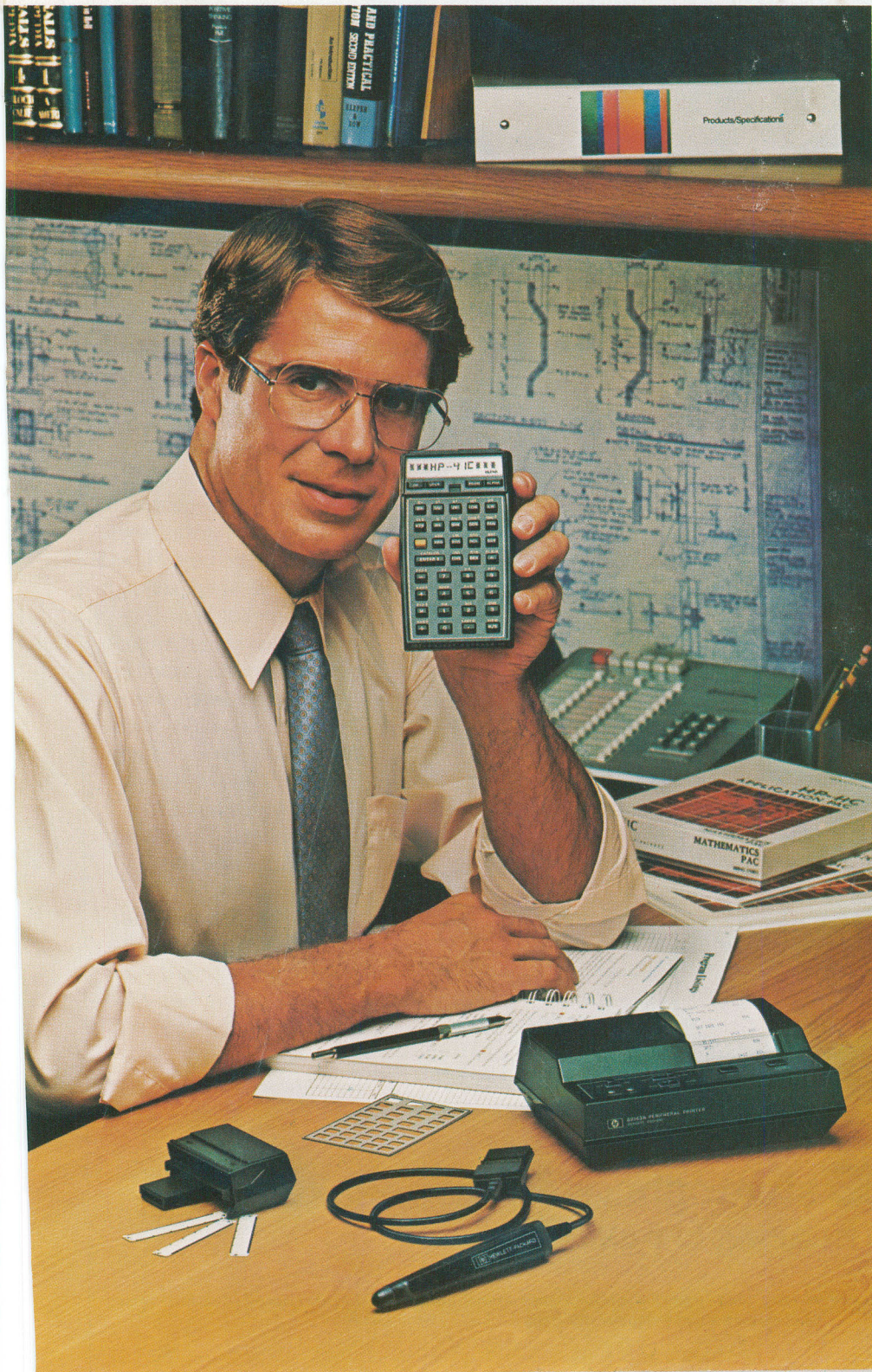
THE WORLD'S LARGEST WRIST WATCH towers over New York's Times Square. The Casio watch on a billboard measures 36 feet across and 64 feet from top to bottom of the band. It displays time in hours, minutes, and seconds (plus a.m./p.m. indication) and, every 15 seconds, switches over to display month, day, and day of week . . . **AND THE WORLD'S THINNEST** is only 0.98 mm thick. The Concord Delerium IV watch's minute and hour "hands" are on two separate discs that revolve on the face of the timepiece. The watch also uses the world's smallest battery, motor, and quartz tuning fork, and a microprocessor for electronic time and time-zone setting. Solid-gold backplate and face are integral parts of the working system. Claimed accuracy is within 10 seconds per month. You can buy the thin one for \$15,000.

AN INFORMATION-RETRIEVAL SYSTEM for home and office use has been unveiled by Radio Shack. Users of the equipment will be able to carry on keyboard "conversations" with a central computer over the telephone line and view results on their color or monochrome TV receivers. Information expected to be available include weather, news, stock reports, transportation schedules, library data, electronic banking, software exchange, news and computer games. Called TRS-80 Videotex, the two-way system will be made available in several configurations. One, designed for owners of personal computers, is a software package that converts TRS-80 and several other makes of computer into a Videotex device. Another is a Videotex terminal ("hardware") that attaches to the telephone line and antenna terminals of any TV receiver. Announced prices are \$30 for the software package, \$400 for the hardware options packages.

MOST USEFUL TV RECEIVER FEATURES, according to a nationwide consumer survey conducted by Venture Development Corp., Wellesley, MA, are high-quality speakers, automatic tuning, and "energy saving." Reduced power consumption was cited more often as "very useful," but it fares only modestly in attracting consumer dollars, its worth averaging only an extra \$41. Six out of 10 consumers feel that high-quality TV sound would be worth an extra \$66 for better speakers and more than \$80 for built-in stereo sound. Automatic tuning through VIR (vertical interval reference) was considered very useful by 41.5% of consumers, who felt it was worth an extra \$48. Other high-technology features, didn't fare so well.

AM SPECTRUM OPENED BY FCC makes it possible for 125 new AM stations to get on the air. The new stations will operate on or next to channels now reserved for 25 special nighttime stations. According to the ruling, 100 new stations can operate on channels now occupied by clear-channel stations but must be outside the 750-mile protection radius given to long-distance stations. An additional 25 stations will be on adjacent channels. Fourteen of the latter already share nighttime use of their channels with other stations, but the adjacent channels were previously off limits to other operators.

HP-41C. The calculator that changes with your needs.



POWERFUL AND FLEXIBLE

As your professional problem-solving requirements change and grow, you may find yourself having to upgrade to a more powerful calculator. Not so with the HP-41C. By itself, the HP-41C could easily be all the calculator you'll ever need. It has a resident memory of over 400 lines, or 63 data registers, or any combination. It has over 130 functions. And any function, or any program, may be assigned to any key—allowing you to customize your HP-41C to meet your specific needs. The HP-41C Continuous Memory retains your programs, data, and key assignments even after the calculator is turned off. And it is alphanumeric: programs may be named, output can be labeled, error messages and prompts appear in words.

PLUG-IN PERIPHERALS, TOO

But if you need more problem-solving power, the HP-41C can become a complete personal computation system. Expand memory to 2,000 lines. Add a Card Reader, an Optical Wand that inputs bar-coded programs, a Printer that also plots, and Plug-in Application Modules that provide solutions to problems in business, science, and engineering. The HP-41C Owner's Handbook can guide even novice programmers to problem solution with easy-to-understand, step-by-step procedures.

ENQUIRE, NOW

Visit a Hewlett-Packard dealer now. And make a decision you can live with. Buy an HP-41C. For details and the address of your nearest dealer, CALL TOLL-FREE 800-547-3400, Department 254T, except from Hawaii or Alaska. In Oregon, call 758-1010. Or write to Hewlett-Packard, 1000 N.E. Circle Blvd., Corvallis, OR 97330, Dept. 254T.

610/14



CIRCLE NO. 33 ON FREE INFORMATION CARD

Introducing a totally new concept in stereophones.

The new Koss HV/X high velocity stereophone represents a remarkable breakthrough in hear-thru stereophone design and performance. For the first time, Koss engineers have been able to create a lightweight, hear-thru stereophone that combines the transparency of high velocity phones with the superior bass performance of closed-type phones. The result is a breathtaking musical experience.

CONTOURED VARIABLE-DENSITY EARCUSHIONS

While most lightweight, hear-thru stereophones have earcushions that fit against the ear, the new Koss HV/X features a unique, contoured, variable-density cushion that fits around the ear. Not only does this unique earcushion design create a far more comfortable stereo-
phone but it has also allowed Koss engineers to create a dramatically better element



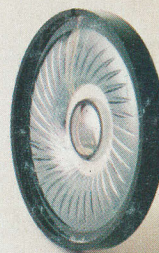
design as well.

These new variable-density earcushions are made up of a very porous material that is acoustically transparent at the perimeter of the earcushion yet compressed toward the center region. This varies the pattern of acoustic resistance over portions of the earcushions creating the proper seal for specific bass frequencies while al-

lowing the flow of middle and high frequencies at the perimeter of the earcushions.

LIGHTWEIGHT ELEMENT

The uniqueness of the new variable-density earcushions made it possible



for Koss engineers to design a lightweight element that reproduces a Sound of Koss you have to hear to believe. Incredibly, even though the overall weight of the element was reduced, Koss engineers were able to develop a magnet with enough magnetic density to drive an extra large diaphragm. With a response range of 15 to 35,000 Hz, the new Koss HV/X will drive you into ecstasy and our competitors nuts.

HEARING IS BELIEVING.

Slip into the new Koss HV/X or HV/XLC with volume/balance controls at your audio dealer soon. You'll like the best of both worlds: the open, airy, upfront sound of hear-thru stereophones and the deep, rich bass performance of closed-type stereophones.

And while you're with your audio dealer, listen to our full line of Koss stereophones and CM loudspeakers. There's no sound quite like the Sound of Koss.

For more information on the HV/X, our full line of stereophones and loudspeakers or our new Koss K/4DS digital delay system, write c/o Virginia Lamm.

© 1980 Koss Corp.

KOSS® stereophones/loudspeakers
hearing is believing™